ASSISTANCE

Adapted situation awareneSS tools and tallored training curricula for increaSing capabiliTie and enhANcing the proteCtion of first respondErs

European Commission

Project co-funded by the European Union within the Horizon 2020 Programme

Project Ref. N°	ASSISTANCE H2020 - 832576
Start Date / Duration	May 1, 2019 (36 months)
Dissemination Level[1]	PU (Public)
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Deliverable D8.6

Best Practices Handbook

31/10/2021

[1] PU: Public; PP: Restricted to other programme participants (including the EC services); RE: Restricted to a group specified by the Consortium (including the EC services); CO: Confidential, only for members of the Consortium (including the EC services).

ASSISTANCE

Nowadays different first responder (FR) organizations cooperate together to face large and complex disasters that in some cases can be amplified due to new threats such as climate change in case of natural disasters (e.g. larger and more frequent floods and wild fires, etc) or the increase of radicalization in case of man-made disasters (e.g. arsonists that burn European forests, terrorist attacks coordinated across multiple European cities).

The impact of large disasters like these could have disastrous consequences for the European Member States and affect social well-being on a global level. Each type of FR organization (e.g. medical emergency services, fire and rescue services, law enforcement teams, civil protection professionals, etc.) that mitigate these kinds of events are exposed to unexpected dangers and new threats that can severely affect their personal safety.

ASSISTANCE proposes a holistic solution that will adapt a well-tested situation awareness (SA) application as the core of a wider SA platform. The new ASSISTANCE platform is capable of offering different configuration modes for providing the tailored information needed by each FR organization while they work together to mitigate the disaster (e.g. real time video and resources location for firefighters, evacuation route status for emergency health services and so on).

With this solution ASSISTANCE will enhance the SA of the responding organisations during their mitigation activities through the integration of new paradigms, tools and technologies (e.g. drones/robots equipped with a range of sensors, robust communications capabilities, etc.) with the main objective of increasing both their protection and their efficiency.

ASSISTANCE will also improve the skills and capabilities of the FRs through the establishment of a European advanced training network that will provide tailored training based on new learning approaches (e.g. virtual, mixed and/or augmented reality) adapted to each type of FR organizational need and the possibility of sharing virtual training environments, exchanging experiences and actuation procedures.

ASSISTANCE is funded by the Horizon 2020 Programme of the European Commission, in the topic of Critical Infrastructure Protection, grant agreement 832576.

Disclaimer

Executive Summary

Societal Impact Assessment is a multidisciplinary endeavor. It requires technical expertise in different fields and at the same time a good understanding of broader societal issues and non-technological effects of technologies and solutions.

This deliverable presents a methodological approach to deal with societal aspects of projects in the context of protection of first responders. Principles and methods applied are provided and illustrated through examples that have been proven to produce useful results within the ASSISTANCE project and therefore deserve to be shared for assisting further similar actions. The reference examples focused on Societal Impact Assessment principles applied to three subjects: 1) the project, 2) the First Responders and 3) the EU citizens. The document has been developed by the University of Cantabria (UC).

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Change control datasheet

Version	Changes	Chapters	Pages	Date
0.1	Table of contents	All	11	27/08/21
0.2	First version for internal review	All	54	08/10/21
0.3	Version for partners review	All	57	19/10/21
1	Version for submittal	All	57	28/10/21

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Acronyms

AR	Augmented Reality
AT	Analysis tool
CTA	Constructive Technology Assessment
D#.#	Deliverable number #.# (D1.1 deliverable 1 of work package 1)
DoA	Description of Action of the project
EC	European Commission
EMS	Emergency Medical Service
EU	European Union
FRs	First Responders
H2020	Horizon 2020 Programme for Research and Innovation
IAIA	International Association for Impact Assessment
ICGP	Interorganizational Committee on Principles and Guidelines
IQR	Interquartile range
IFC	Informed Consent Form
GELS	Gender, Ethical, Legal and Societal
KPI	Key Performance Indicator
LEA	Law Enforcement Agency
M#	#th month of the project (M1=May 2019)
MT	Monitoring tool
PD	Pilot Demonstration
PIA	Privacy Impact Assessment
R&D	Research and Development
R&I	Research and Innovation
RQF	Research Quality Framework
SA	Situation Awareness
SIA	Societal Impact Assessment
SO#	Specific Objective
TA	Technology Assessment
TW	Training Workshop
UC	Use Case
VR	Virtual Reality
WP	Work Package
SAT	Self-Assessment tool
SIA	Societal Impact Assessment
S&S	Safety and Security

1. Introduction

This Best Practices Handbook gives an overview of the Societal Impact Assessment approaches and methods conducted within the ASSISTANCE project defining procedures and recommendations for stakeholders.

Based on the activities conducted in Task 8.4.- Societal Aspects this document represents the experiences accumulated within the first 30 months of the project. It does not only present an overview of the applications and results but reflects the lessons learnt providing practical guidelines on how to deal with societal impacts in research and innovation (R&I) projects related to the protection of first responders.

The aim of compiling the handbook was to facilitate the dissemination of principles, methodologies, and outcomes in the form of "good practices" ensuring the transference of the gained knowledge during the project that, we believe, deserves to be shared thus encouraging the application of Societal Impact Assessment approaches.

Who is the Best Practice Handbook for?

The target audience for this handbook includes those researchers, technology providers, first responders and policymakers seeking for advice on how to assess non-technical subjects within safety and security projects.

What does the document look like?

State of the art

Section 2 dwells on "Societal Impacts" presenting the main concepts, key questions and an integrated picture of Societal Impact Assessment methodologies.

The proposed approach

Section 3 describes the guiding principles of the proposed approach and the overall strategy for assessing societal impacts.

Practices/examples

Section 4 presents a case study conducted for assessing in advance the consequences likely to follow from project developments.

Section 5 describes a case study conducted to get information of end-users' past experiences.

Section 6 introduces a toolkit for assessing non-technical aspects (gender, ethical, legal and societal) during pilot demonstrations.

Section 7 describes a case study through a consultation process to explore citizens perceptions and attitudes.

Conclusions

Section 8 provides conclusions and further actions.

2. Societal impact in a nutshell

2.1. What is Societal Impact?

The societal impact is a significant topic (2.660.000 results from Google Scholar) since it comprises issues that directly or indirectly affect people due to interventions, projects, products, services, activities or policies. Hence all projects have a societal impact of one form or another as they are carried out in society and their results are introduced into society.

An easy way to create a picture of societal impact is to describe it as a real or potential change produced in relation to the following aspects: 1) people's way of life, 2) their culture, 3) their community, 4) their political systems 5) their environment, 6) their health and wellbeing, 7) their personal and property rights and/or 8) their fears and aspirations. The complexity of societal impact is apparent as it covers everything that affects individuals and communities at different levels, in many ways and several fields (economy, health and safety, education, engineering, policy, environment, etc.).

2.2. How to assess the societal impact of a R&I project?

A pertinent question is how one can assess the societal effects of a R&I project? Unfortunately, the answer to this question is not straightforward. We may look at three general approaches from the literature and transferred them into a project context: 1) Privacy Impact Assessment (PIA), 2) Constructive Technology Assessment (CTA), and 3) Societal Impact Assessment (SIA) (Bornman, 2013; Takyi, 2014; Kreissi et al., 2014). The PIA is a methodology for assessing the impacts on privacy of a project and its technologies in consultation with stakeholders for taking remedial actions to minimize negative impacts. The CTA is a thorough strategy designed in a reflexive manner while getting information of technologies from a societal impact perspective (Kreissi et al., 2015). The SIA is a research approach likely to be applied through participatory techniques involving stakeholders (end-users, citizens, etc.) and the research team in constant evaluation of the developments.

2.2.1. Privacy Impact Assessment (PIA)

The PIA refers to the process for evaluating the potential effects on privacy of a project. This practice aims to assess technologies in relation to the risks that they may pose for infringements of privacy. Its use has become more common from the mid-1990s. PIA varies from case to case in scale and scope, the actors involved and the publicity and transparency of the process.

A review of PIA can be found in (Clarke, 2009) and the state of the art can be found in (Wright, 2012). There are comprehensive guidelines of reference when conducting PIA. But there is no standard methodology for surveillance impact assessment. Based on PIA methodologies and best practices Wright and colleagues identified aspects to improve EU legislation regarding data protection (Wright et al., 2013). Transparency is key benefit: "*The more open and transparent the process is, the more likely the organization is to overcome apprehensions, suspicions and mistrust in the development of a new service, product, policy, programme or project*" (Wright and De Hert, 2012).

The same is applicable to surveillance impact assessment concerning ethical and social implications (Prainsack and Ostermeier, 2013). Wright and Wadhwa proposed 16 steps applicable to PIA and surveillance impact assessment (Wright and Wadhwa, 2013). Similarly, surveillance impact assessment consists of following a similar process as PIA (Wright and Raab, 2012). The difference between PIA and surveillance impact assessment is its scope. The surveillance impact assessment should first describe the technologies in question i.e. "covert or visible?", "watching, listening, detecting?", "does it draw on biometrics?" "dataveillance?" and the issues and impacts that can emerge from surveillance technologies: individual, social, economic and financial, political, legal, ethical and psychological (Wright and Raab, 2012).

2.2.2. Constructive Technology Assessment (CTA)

The Technology Assessment (TA) is the evaluation of technologies assuming the importance of ethics (i.e. avoiding potential negative impacts to people). The TA initially included public perceptions and opinions for assessing new technologies (John and Van de Graaf, 1996; Vig and Paschen, 2000). Within this context the CTA focuses on short-term design and development stages rather than potential impacts of the technology at hand. The main idea behind this approach is that the development of new technologies needs to be performed through a dialogue and interaction between developers and end-users/or stakeholders. In other words, CTA is a specific approach to test technologies in "society" rather than in a "laboratory" (Genus and Coles, 2006).

A key point of CTA is to identify the opportunities of intervention and how such interventions can be as productive as possible. Pilot demonstrations, workshops, scenario workshops, public debates, or reports are the most common CTA activities. There are three CTA strategies: 1) technology forcing, 2) strategic niche management and 3) alignment (Schot and Rip, 1997). Technology forcing means technology development from the demand side (i.e., end user requirements). Strategic niche means the creation of controlled experimental environments. Alignment analyses interaction between people and technology focusing on the dialogue to balance perspectives. Similarly, CTA process has three elements: 1) anticipation, 2) reflexivity and 3) social learning (Genus and Coles, 2006). Anticipation involves end-users and stakeholders taking part in the design processes. Reflexivity considers that technological effects also depend on the interactions between designers and end-users. Social learning can be divided into: the first-order learning to specify and define one's own design and the second-order learning showing that one is creating new combinations and demands. References of best practices in CTA can be found in Rip and van Lente, 2013.

2.2.3. Societal Impact Assessment (SIA)

According to the International Association for Impact Assessment (IAIA) the SIA is the processes of analysing, monitoring and managing the consequences, both positive and negative, of projects and any social changes caused by those interventions. In general terms, SIA can be defined as evaluating the social consequences of a project. More specifically SIA refers to a set of methods and principles to identify the societal effects of new technologies, programmes and projects (Kreissi et al., 2015). One of the main purposes of SIA is to predict and mitigate negative impacts and identify opportunities to enhance benefits.

A short story of the SIA can be found in (Esteves et al., 2012). The field of SIA emerged during the 1970s as a response to new environmental legislation. Starting in the domain of environmental issues, SIA has extended to other areas where technologies and research started to shape the everyday life of people. Early contributions to SIA consisted of guidelines and handbooks with general aspects and best practices (Finsterbusch, 1980; Finsterbusch and Wolf, 1977; Finsterbusch et al., 1983; Leistritz and Murdock, 1981). The IAIA was established in 1981 to support SIA implementations. The Guidelines and Principles for SIA published in 1994 by the Interorganizational Committee on Principles and Guidelines for Social Impact Assessment (ICGP) is perhaps the most well-known reference of these early contributions (Guidelines and principles for social impact assessment, 1994). Since then, researchers and policy makers have examined the "impacts" of several developments. However, nowadays (several years later) there is not a common conceptual view or methodology of SIA. One reason is that SIA focuses on several issues (e.g., human rights, social inequality, well-being, health and safety, public participation, etc.) likely to be addressed in different ways. An attempt to create a paradigm in the SIA is proposed in International Principles for Social Impact Assessment (Vanclay et al., 2015). This guidance introduces good practices in accordance with the IAIA and proposes four phases: 1) understand the issues, 2) predict, analyse and assess the likely impact pathways, 3) develop and implement strategies and 4) design and implement monitoring programs. Kemp proposed a list of actors to be considered when assessing societal impact (Kemp, 2011) and Becker (Becker, 2001) defined two main steps for this process: 1) preparatory phase focused on an analysis of the project and 2) scenario build technique to recognise future effects of the project.

SIA in research and application has been widely discussed in a paper (Bornman, 2013) that presents practices in the assessment of societal impact including approaches of national evaluation systems. Firstly, the Netherlands system considers three parts: 1) societal quality (efforts to interact with stakeholders), 2) societal impact (how research affects stakeholders or procedures) and 3) valorisation (actions to make results available and suitable for application). An important process mentioned by the ERiC project is conducting productive interactions between researchers and stakeholders during and/or after the research (Van der Meulen, 2010). Secondly, the UK Excellence Framework (Erno-Kjolhede and Hansson, 2011) proposes expert panels to review the narrative evidence of case studies supported by indicators and measuring the impact in a quantifiable way. Similarly, the Australian Research Quality Framework (RQF) (Donovan, 2008) suggests a quantitative and contextual approach where information is seen as context statements, impact statements, case studies and relevant qualitative and quantitative indicators. Finally, methods and indicators are also developed by Finnish research organizations (Lähteenmäki-Smith et al., 2006) proposing five dimensions of impact: 1) impact on economy, technology and commercialization, 2) impact on knowledge, expertise, human capital and management, 3) impact on networking and social capital, 4) impact on decision making and 5) impact on social and physical environment.

Although there is not a common SIA methodology, guidelines and handbooks provide general principles like public participation and scientific and valid methods (Jacquet, 2014). A key point of SIA is the use of participatory and anticipatory strategies to gain a clearer understanding of the impact produced by a given activity, development or project. However, such strategies have social and cognitive problems (Kreissi et al., 2015). In relation to social problems, the development of an inclusive approach considering the perspective of different stakeholders could be challenging because this process usually focuses on specific topics rather than core aspects. Regarding cognitive problems, the main limitation is tracking the future of technologies and therefore their likely impacts.

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3. Paving the way

3.1. The problem

Literature review has shown different concepts and approaches for assessing societal impacts. However, there is no standardized methodology to address this subject matter for safety and security innovation projects. This is because such projects, like many others, may entail societal issues likely to be addressed in several ways. Also, cause-effects relationships are not always clear and societal impacts can be diffuse, complex and contingent and can occur at different levels.

Indeed, societal impact has the typical attributes of a complex system: 1) usually represented by the sheer number of involved variables; 2) mutual dependencies between variables, 3) dynamics of the situation, which reflects the role of time and developments within a system, 4) lack of transparency (in part or full) about the involved variables and their current values and 5) polytely (greek term for "many goals"), representing goal conflicts on different levels of analysis. Given this, it is apparent that no single approach/method can provide a suitable way to address all societal topics within a R&I project. That is why in most cases societal impact assessment combines several methods while relying on the criteria, knowledge, and creativity of the researchers/analysts.

3.2. The guiding principles

The proposed strategy is not a standardized methodology. However, it can provide insights to deal with the mentioned problems. Complex problem solving has inspired the current approach which is based on the ideas displayed in Table 1. Anticipating, focussing on essentials, dividing into parts, getting feedback and feedforward and using multiple scientific-based methods are the guiding principles in our approach to deal with societal impacts.

From the beginning	Planning from the early stages of the project (e.g., innovation ideas and during preparation phase) while trying to address the concerns and requirements about societal impacts of the funding organization, if any. The key question to have in mind is: *How would the project change the individuals and communities?*
Effort on essentials	Simplifying and focusing on the essentials to get a satisfactory analysis. In the case of safety and security projects, this means paying attention to the current and possible future state of stakeholders (e.g., end-users, population) regarding being safe and protected from danger or harm without negative changes on ways of life, culture, community, political systems, environment, health and wellbeing, personal and property rights and/or fears and aspirations.
Divide and conquer	Dividing the problem into parts and addressing these individual parts before connecting them to make a whole. Issue trees can be used by braking societal issues/topics into parts that can be broken into sub-parts. The parts and sub-parts would be as mutually exclusive as possible meaning that the sub-parts do not interfere with each other (interference is complexity). The more mutually exclusive the parts the more efficiently they can be addressed.
Feedback & feedforward	Getting information or opinions about the current situation (what needs to change?) and how the future situation would be (what is likely to change and how?). This entails identifying the target groups and participants likely to be involved (e.g., citizens, project partners, and end-users) and engage them through cooperation in different phases of the project, when required.
Multimethod approach	Application of scientific-based methods (quantitative and qualitative) for different participatory actions during the course of the project (e.g. anticipatory and scenario-based).

Table 1 Basic ideas to assess societal impacts for safety and security innovation projects.

3.3. The overall strategy

In the following we illustrate the strategy used to analyse and measure the societal impacts of the ASSISTANCE project. This project offers technologies and novel training solutions aimed at protecting First Responders (FRs) and enhancing their capacities when faced with severe disasters. Hence this project can be seen as a planned intervention which potentially has net effects upon FRs as end-users and citizens as indirect beneficiaries, and therefore the society. The proposed strategy focuses on three parts (Figure 1): 1) the project itself (intended and unintended potential outcomes), 2) the perspectives of end-users (when adopting technologies and novel solutions) and 3) citizens perceptions and attitudes (towards safety & security).

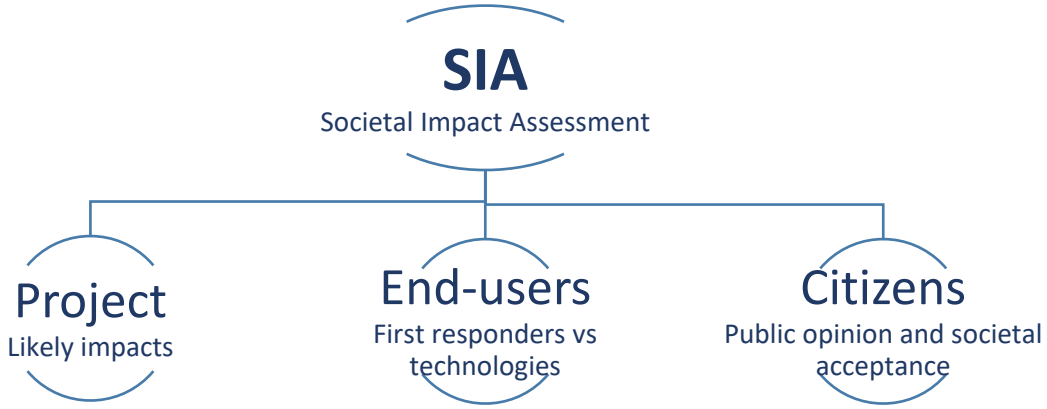


Figure 1: Overall research strategy applying Societal Impact Assessment to ASSISTANCE.

Project: This part involves an anticipatory strategy to identify the needs covered by the project, its potential impacts (positive/negative), and its likely benefits to society. The main purpose is to gain a better understanding of the effects the project may produce in the short-, medium-, and long-term. SIA can be seen here as the process of assessing in advance the consequences likely to follow from project developments.

End-users: The purpose of this part is to explore the attitudes and behaviour of direct end-users when evaluating, testing and/or using the technologies and solutions proposed by the project. The idea behind this is that a purely techno-centric approach is insufficient and a participatory approach through the inclusion of stakeholders in design, testing and implementation processes is necessary. Special attention should be paid to productive interactions between the research team and end-users especially during pilots and demonstrations. SIA can be seen here as a process of discussion and negotiation on short-term design and construction stages of technologies and solutions from a societal perspective rather than future impacts.

Citizens: Although R&I projects mainly focus on covering the needs of the direct end-users, this part aims to gain knowledge about public opinion regarding safety and security and to explore social acceptance. SIA can be seen here as survey research involving citizens to analyse subjective social indicators (e.g., individual perceptions, self-reports, and opinions) as well as to determine perceptions (e.g., acceptance) of the project developments.

The following sections describe the best practices conducted in the ASSISTANCE project to address the three societal perspectives described above (i.e., Project, End-users and Citizens). These practices are successful experiences that have been proven to work well and in a broad sense we believe it could be leveraged by other interested parties to be used as reference. We have followed the criteria in Table 2 for identifying and reporting our examples.

Effectiveness	The described practices have worked and/or achieved results that are measurable.
Efficiency	The proposed practices have a reasonable level of resources and time.
Relevance	The proposed practices have addressed the targeted societal parts (Project, End-users and Citizens).
Ethics	The practices are compliant with applicable rules and ethics.
Technical feasibility	The practices are easy to learn and to implement.
Inherently participatory	Participatory approaches are essential. The proposed practices have been designed to and/or effectively involve stakeholders.
Duplication	The proposed practices, as designed and carried out, have the potential for replication and can therefore be adaptable to similar objectives in varying situations.

Table 2 Criteria used to identify and report the best practices.

4. Project: Likely impacts

The problem

The early analysis of societal impacts of new projects, technologies and solutions has become a crucial process to anticipate negative effects and identify opportunities. During the proposal phase or when the project has just started, it is necessary to focus on the following question: What are the most likely impacts of the project on individuals and communities? In other words what subject matter will be analysed? Dealing with these questions entails some problems:

- **Relying on experience:** Researchers usually assigned for this endeavour must address these questions based on their experience and/or expertise. This approach may keep the rest of the project partners away from the analysis and discussion of societal effects potentially generated by the project.
- **Abstract nature and variety of societal aspects**: The term "societal" includes anything that affects humans (e.g., culture, economy, social, health, working conditions, quality of life, environment, etc.)[8]. This makes categorization and selection of societal matters a difficult activity.
- **Tracking the future is difficult**: The proposed technologies and solutions by innovation projects have not been widely implemented into society yet. Therefore, there is inherent uncertainty when attempting to track their future effects. Innovation does not always occur in a linear and predictable way; it can also progress in a complex manner that may also involve unplanned or unintended effects on society.

The approach

Group decision-making involving project partners is a plausible approach to minimize these problems. It is based on participation and democratic consensus, and it can provide helpful information for further societal analysis during the project. There are several group decision-making techniques (e.g., brainstorming, nominal group technique, multi-voting, focus groups, Delphi method). In ASSISTANCE, for example, a case study was conducted using a Delphi consensus procedure involving project partners (end-users, technology providers and researchers). A twofold objective was achieved:

- To establish a consensus on the identification and prioritization of impact categories for evaluating societal impacts of the project
- To encourage all people involved in the project to think about and discuss non-technical aspects

The consensus definition of impact categories provided guidance to prioritize and suggest subject matter for assessing and measuring societal impacts during the project.

Implementation

The Delphi method has proven to be an accurate instrument to generate forecasts in research. It basically comprises a set of questionnaires sent to respondents in several rounds (normally two and rarely more than 3 rounds) allowing participants to refine their responses as the process progresses.

The Process: The flowchart in Figure 2 shows the phases and processes of the Delphi technique involved. In Round 1, participants were asked to independently rank the likely impact of the project on 56 statements across eight societal domains (Table 3). Data on participants were also collected including gender, range of age and profile/profession. Responses to questions/statements (56) in Round 1 were summarized and presented to participants in a 45 min teleconference. The Round 2 questionnaire included 29 categories that survived Round 1. The median scores of each statement from the previous questionnaire were included in this second round.

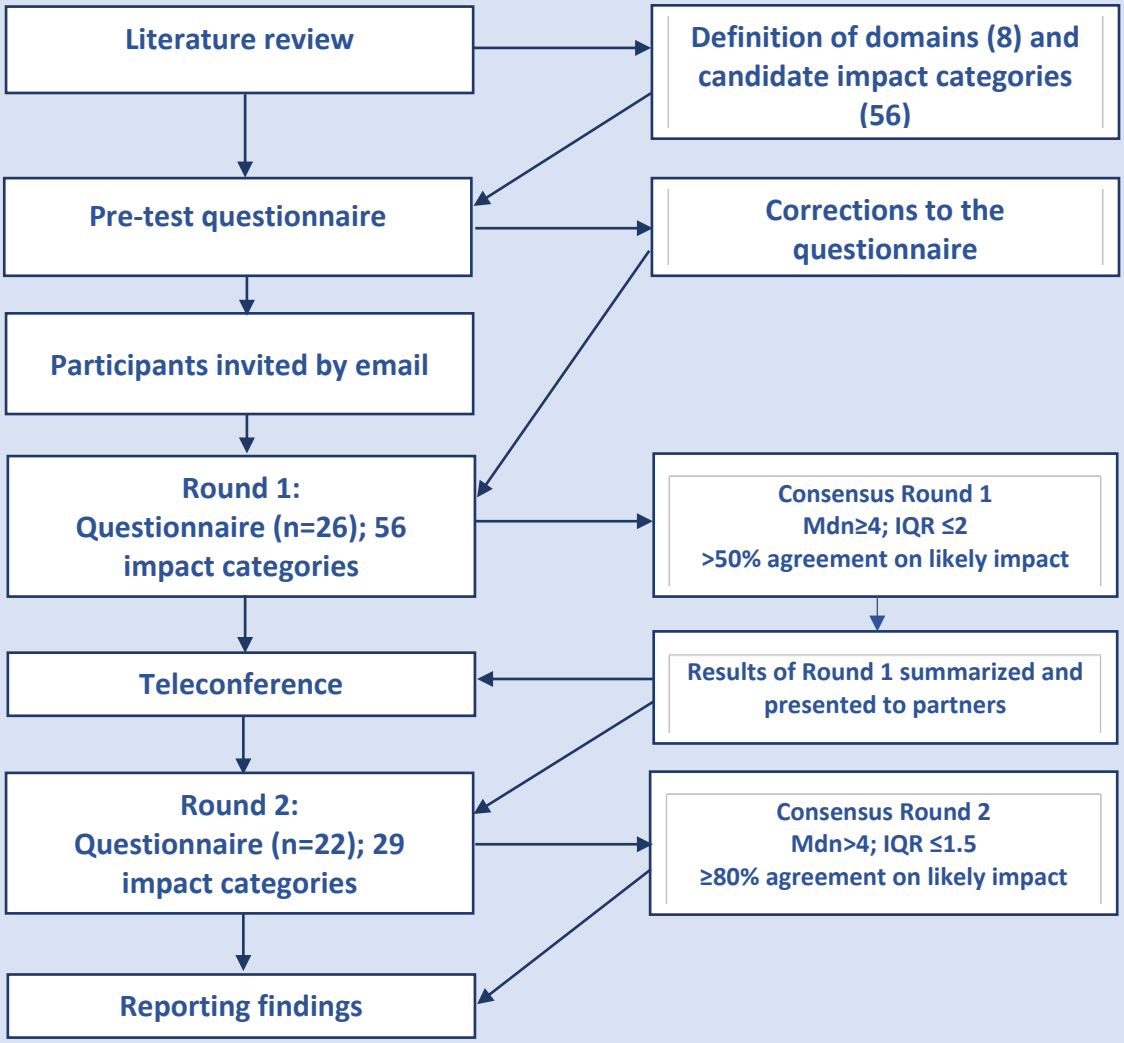


Figure 2: Delphi process applied to ASSISTANCE.

The questionnaires: Whereas it was necessary to consider as many societal aspects as possible, the defined dimensions were broken down from a high level of abstraction into more operational elements. Therefore, a set of categories was proposed from societal dimensions (Table 3). The key question included in the questionnaire was: "*To what extent do you think the ASSISTANCE project would change aspects related to…*" followed by statements describing the proposed categories. Each item (statement) had 6 potential responses ranging from 1-6 (1=Definitely not; 2=Probably no; 3=Possibly; 4=Probably; 5= Very probably; 6=Definitively). A pre-test was conducted to check the first questionnaire for proper wording (e.g., ambiguities, vagueness). The final survey process was managed using the online survey tool Google Forms with each questionnaire designed to take around 15 min to complete. Participants were sent a link to the questionnaires with an explanation of the Delphi process.

Domain	Impact category	Domain	Impact category
Health and Safety (HS)	HS1) Injury HS2) Mental/physical demands on duty HS3) Healthcare HS4) Comfort/mobility HS5) Assistance of injured FRs HS6) Physical protection HS7) Citizens response/evacuation	**Organization (O)**	O1) Decision-making O2) Management O3) Planning and procedures O4) Intervention strategies O5) Workforce organization O6) Division of labour O7) Recruitment
Training (T)	T1) Curricula T2) Qualifications T3) Promotion T4) Fitness T5) Pedagogical tools T6) Use of technologies T7) Specialization	**Culture (C)**	C1) Tradition and values C2) FRs reputation C3) Risk perception C4) Self-protective behaviour C5) Tactical/strategic knowledge C6) Citizens' awareness C7) Acceptance of technology
Society (S)	S1) Working-life balance S2) Gender equality/equity S3) Interaction between coworkers S4) Interaction between FRs and citizens S5) Voluntary service S6) Vulnerable population S7) Community involvement	**Research and Innovation (RI)**	RI1) Multidisciplinary RI2) Collaboration on science and education RI3) Targeting of future research RI4) Dissemination RI5) Research skills/ overall research capacity RI6) Staff development RI7) Gendered perspective
Economy (E)	E1) Financing E2) Investments E3) Commercialization E4) Productivity E5) Job creation E6) Wage/salary E7) Cost of product/service	**Policy (P)**	P1) Political and executive decisions P2) Standards and references P3) Privacy and data protection P4) Rights and freedoms P5) Right to information P6) Ethical compliance P7) Retirement

Table 3 Societal domains and impact categories considered for the Delphi process applied to ASSISTANCE.

Ethics: The questionnaires were anonymous since the survey did not aim to identify the participants. Given that no personal data have been gathered or processed, consent of the participants for the data processing was not required. Nevertheless, the informed consent procedure has been followed for the participation in the online survey, i.e., the respondents have been given information on the research activity and on its anonymous character and checked a relevant box prior to filling in the questionnaires (agreement part of the survey form).

Participants: The invited participants were either First Responders or technical partners (researchers/technology providers) involved in the project. In total 26 respondents (FRs n=10; technical partners n=16) completed the Round 1 and 22 respondents (FRs n=8; technical partners n=14) completed the two rounds (dropout of 16 %).

Measures: Descriptive statistics were used to measure the responses: Median (degree of likely impact for a given item), percentage of the responses fall into 4-6 scores (weight of likely impact) and interquartile range (IQR, degree of consensus among the participants). The consensus was defined if each category meets the criteria presented in Table 4. Then, categories were rated as 1) "High" likely impact (fulfil all criteria), 2) "Moderate" likely impact (fulfil two criteria) and 3) "Low" likely impact (fulfil one or none of the criteria).

Criteria for Round 1	Criteria for Round 2
Median ≥4	Median >4
Scores 4-6 >50% of participants	Scores 4-6 ≥ 80% of participants
IQR ≤ 2	IQR ≤ 1.5

Table 4 Criteria to filter impact categories each round. Scores 4-6 correspond to "Probably", "Very probably" and "Definitely" responses.

Results

In total 27 categories were rejected during the first round (Figure 3). Some of these rejected categories were related the project activities. It is argued here that participants were biased by the global idea of the project rather than specific tasks of the project. Results from the two rounds were used to develop the final list of likely impacts and to define the subject matter to conduct Societal Impact Assessment within the project (Table 5). Remarkable results were considered important for the following domains: Health and Safety (2), FRs organization (3), Training (2), Research and Innovation (3), Culture (1).

Impact categories of Society, Policy and Economic domains were not considered essential, perhaps denoting the influence of practical and technocratic perspectives of most participants. The majority of the subject matters listed in Table 5 are related to the impacts that the project may have on end-users. A suitable way to analyse this is to gain feedback from end-users during the project. Our approach to do this is described in the next practice (Section 5).

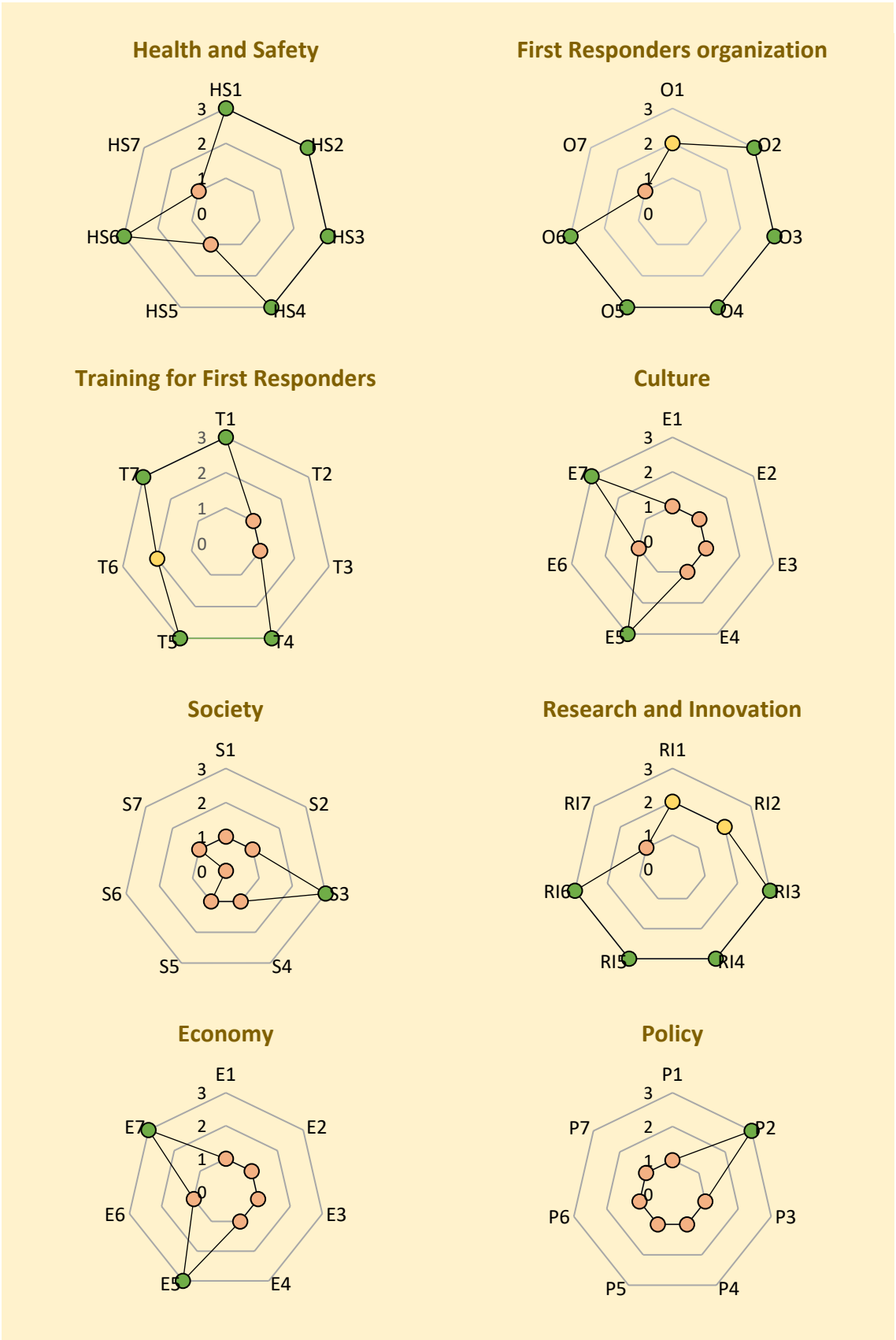


Figure 3: Consensus on likely impacts achieved in Round 1. Likely impact for each category rated as “High” in green, “Moderate” in yellow and “Low” in orange. See Table 3 for the description of the code applied to the impact categories.

Code	Category	Subject matters for SIA
HS1	Injury	Injuries of First Responders on duty
HS6	Physical protection	The provision of physical protection to First Responders
O1	Decision-making	The way First Responders make critical decisions
O2	Management	The way first responders manage disasters
O4	Intervention strategies	The strategies adopted by First Responders
T5	Pedagogical tools	The adoption and the use of new methods of theory and teaching for First Responders
T7	Specialization	The chances for First Responders to develop specific skills and expertise to perform certain activities
C5	Tactical/strategic knowledge	The strategic/tactical knowledge of First Responders
RI1	Multidisciplinary	The combination of several disciplines in research and innovation
RI3	Targeting of future research	The development of new ideas for further research and innovation
RI4	Dissemination	The spreading of information to academy and society

Table 5 Top list of Likely societal impacts for the ASSISTANCE project.

Lessons Learnt

The Delphi process has proved to be a suitable participatory and transparent approach for assessing societal impact since the consensus among a group has more power than individual judgements. It is particularly useful when the goal is to improve the understanding of problems, opportunities or solutions, or to develop forecasts. This practice is recommended and can be extended to Societal Impact Assessment of similar projects.

The success factors are listed as follows.

- Additional information and supporting criteria at early stages of the project to conduct Societal Impact Assessment.
- Participation and involvement of all project partners to think about further societal consequences of the project and its developments.
- The overall process was conducted online reaching all partners and reducing time and cost.
- Anonymity avoided the potential influence of others on individual responses and consent of the participants for the data processing was not required.
- Controlled feedback through a structured process through questionnaires and rounds to reach a consensus.
- Statistical processing of quantitative results that were accepted by the consortium.
- The respondents could think about societal impacts of the project over two rounds and a teleconference, which enhances the validity of the results.
- It was possible to compare the initial perceptions of end-users and technical and non-technical partners.

- It focused on essentials (identify an agreed list of top impact categories) for further practical analyses.
- One-group post-test-only design is likely to be conducted by using the same Delphi process at the end of the project to explore the effects of the actual project activities and outcomes according to the partners.

The identified constraints are the following:

- The criteria to define consensus was arbitrary.
- The definition and classification of societal domains and categories needed a full understanding of the project and an additional effort to figure out its potential effects.
- The process required the commitment of the participants, but the repetition of questionnaires led some to withdraw.
- Respondents had different perceptions about the overall project, its activities, and its outcomes.
- Consensus does not necessarily mean the correct answer. It simply described those societal effects relevant for the project partners.
- Technocratic and practical perspectives dominated the consensus process. Respondents reached consensus when scoring the likely impacts that were easier to track/predict, such as the potential improvements for the research team, the changes for end-users of the future system.
- Identifying societal impacts at a glance was not easy for respondents. Some impacts were not so evident (e.g., complex relations between technologies and their potential effects) and were dismissed.

5. End-users: Past experiences

The problem

Knowing the current situation of end-users and stakeholders may help to assess the potential changes that an innovation project may produce. In other words, whether the proposed technologies and solutions are deemed to change/improve the way of life, the culture, the way to organize, the environment, the health and safety, the rights, and wishes of end-users and stakeholders. Therefore, there is a need to conduct a quantitative and contextual approach by considering as many societal aspects as possible.

The approach

During the proposal phase of the ASSISTANCE project a short questionnaire was conducted involving 18 first responding organizations. The questionnaire focused on specific demands of the end users to shape development/innovation. This approach is mentioned here as a good approach and because it inspired the following best practice.

Here we present a survey study conducted during the ASSISTANCE project focused on past experiences of first responders. The study was divided into two parts: 1) online questionnaire and 2) focus group session. The questions derived from the top list of likely impacts defined in the Delphi process (previous example). The outputs provide an overall picture of the current conditions for first responders in relation to the selected societal aspects and technologies. This practice allowed us to:

- Focus on actual information reported by end-users and stakeholders.
- Identify and understand the key societal issues.
- Pinpoint new chances for innovation.

Implementation

Questionnaire

Survey design: A survey was designed following the top list of likely impact categories generated during the Delphi method (see Section 4). It covers first responders' experiences on six subjects: health and safety (4 items), protection (5 items), decision-making (5 items), management (7 items), training-workforce (5) and technology use (14). In addition, respondents were asked to select the technologies integrated in their departments from the following list: Web-based communications, Situation Awareness Platforms, Drones, Wearables (GPS, sensors and/or other devices), Predictive models/simulations, Virtual Reality for training and Augmented Reality for training. Respondents also provided their gender, age, type of service, current position, and the number of years in service.

Survey administration: The questionnaire was generated using Google Forms, a cloud-based survey development application. The target participants of this survey were first responders who were directly or indirectly participating in disaster response (firefighters, police officers, emergency medical service and civil protection personnel). In addition to the type of service, participants were classified as operational, leading and training personnel. The online survey was available in English and Spanish. It was distributed by the project partners through email to internal end users (ASSISTANCE project partners) and external first responders. The survey was also announced through social networks and available on the project website. The web-based questionnaire was distributed on September 15, 2021, with a predefined closure date of September 30, 2021.

Ethics: The questionnaire was anonymous, and the privacy policy of the individual's posted information was noted. Due to the nature of this study and considering that no personal data would being collected or stored, written informed consent was not required. However, respondents gave consent to participate by filling in the agreement part of the survey form.

Focus Group:

Design: Focus group is a qualitative method that enabled us to get an in-depth view about the past experiences of first responders. The purpose was to obtain complementary information on concepts, perceptions and ideas, foster discussion and make it possible to come up with a wide variety of perspectives, experiences and feedback and collect detailed and descriptive data. The topics were divided into three blocks. Block 1 included health, safety and protection, Block 2 was related to management, training and workforce and finally block 3 was about technology. Results from the previous questionnaire were presented and used to elicit the discussion through four core questions for each block (Figure 4-6).

Participants: End users/partners of the project were invited by email. In total 7 first responders participated: 2 Emergency Medical Service (Turkey), 1 Civil Protection (Spain) and 4 firefighters (3 from Poland and 1 from Sweden).

Ethics: Participants were informed that their voice will be recorded. They were told that if they no longer wished to take part in the focus group, they could leave at any time. They were also told that their responses were going to be completely kept confidential and anonymous. All participants agreed to continuing in the meeting.

Process: The focus group session was conducted online and lasted 69 min. The facilitator presented the results of the questionnaire and asked participants to answer the core questions from their own experience. Once each discussion was launched the role of facilitator was to monitor the discussion but not contribute to it, encourage all of the participants to enter the discussion, intervene if the discussion veered off topic by prompting participants to return to the question at hand, and answer general questions but redirect any content-specific questions back to the group.

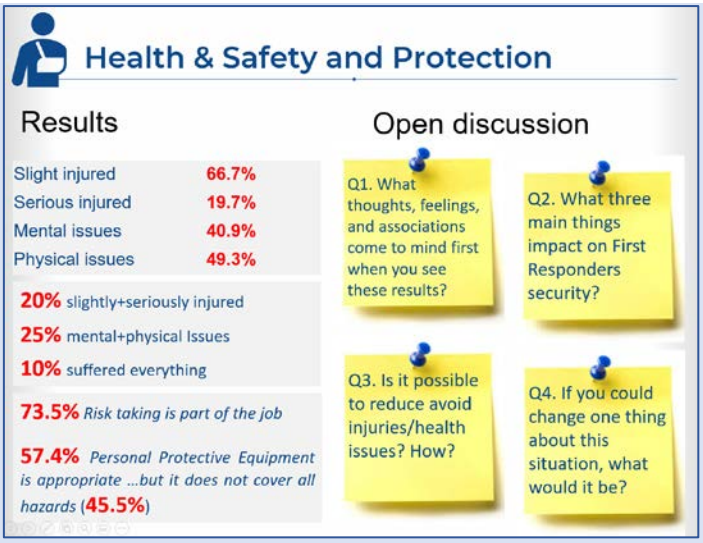


Figure 4: Block 1 of the focus group.

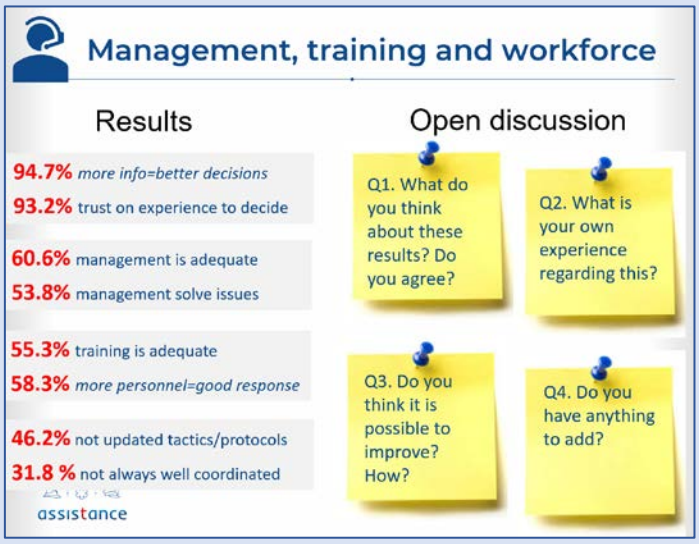


Figure 5: Block 2 of the focus group.

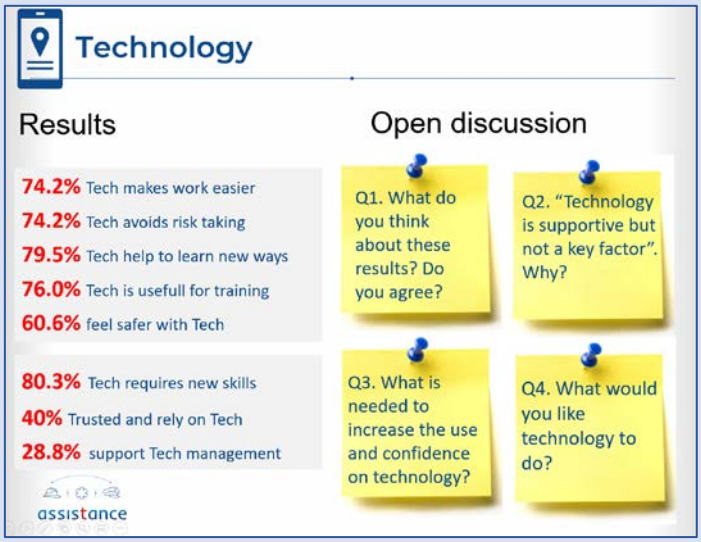


Figure 6: Block 3 of the focus group.

Results

Questionnaire

Participants: A total of 132 respondents (112 males and 20 females) completed the survey. Table 6 shows the characteristics of the surveyed participants. It is important to note that 59% of respondents were firefighters in the frontline.

Variables	Data
Age (years): mean ± SD [min.-max.]	43.40 ± 9.77 [22-68]
Type of service *n* (%)	
Firefighters	96 (72.73)
Civil Protection	5 (3.79)
EMS	12 (9.09)
Police	17 (12.88)
Other	2 (1.52)
Current position *n* (%)	
Operational	98 (74.24)
Leading	30 (22.73)
Training	4 (3.03)
Years of experience *n* (%)	
<1 year	1 (0.76)
1-5 years	14 (10.61)
6-10 years	25 (18.94)
11-15 years	25 (18.94)
16-20 years	27 (20.45)
>20 years	40 (30.30)

Table 6 Characteristics of the first responders who participated in the survey.

Data records: The dataset resulting from the online survey comes in a CSV file. Each row represents one respondent, and each column represents a variable (i.e. one column for each item question). The cell value represents the answer that the respondent gave to the question as ordinal scales. For instance, if the answer had to be given on a scale from 1 (minimum) to 5 (maximum), then the cell value is either 1, 2, 3, 4, 5.

The results are presented here as lists of first responders' past experiences in quantitative terms. Table 7 displays results related to health and safety, protection, management and training-workforce and Table 8 shows the results regarding technology. For binary responses we present results in percentages (%), for Likert scale the variables are expressed as responses reported by the Median (Mdn) i.e. the "middle" value and the Interquartile range (IQR) which is the "midspread" of data.

Health and Safety: Each item in the health and safety scale is binary, and the total number of "yes" indicated by a respondent can be used as an overall measure of that person's physically or mentally hurt on duty. Results in Table 7 revealed that one-fifth of participants have been both slightly and seriously injured and that one fourth have suffered from health issues (mental and physical) due to their profession. Similarly, one out of ten have suffered every health and safety challenge.

Protection: The statement "*Risk taking is part of first responding*" was supported by 73.48% of the surveyed participants. The majority also agreed that their work was mentally demanding (86.36%). Personal Protective Equipment (PPE) was appropriate for 57.38% of respondents. However, such equipment did not cover all possible hazards for 45.45% of respondents. Finally, protective equipment used for COVID-19 was reported as appropriate by 63.64% of respondents.

Decision making: Regarding decision making questions it is important to note that the majority of first responders (94.70%) reported the amount of information as a key factor to make good decisions. In most cases, decisions were made considering all possible alternatives (84.09%) while relying on experience (93.18%).

Management: The results also allowed us to identify the lack of agreement and concerns of first responders in relation to tactics and protocols (not constantly updated for 46.21% and updated for 38.64%) and the coordination of emergency teams (not always well-coordinated for 31.82% and well-coordinated for 45.45%). However, in general respondents had favourable opinions about management and most agreed that women had the same opportunities to advance as men in their profession (75.00% of female respondents and 76.77% of male respondents).

Training-workforce: Results also show opinions of respondents on training. 55.29% of respondents reported that training was suitable to them, 50.75% stated that trainees were adequately supervised and 59.84% that their unit/area did a good job training new personnel. More personnel were supported by 58.33% of respondents and 48.48% though that the level of staffing was insufficient to handle emergencies/disasters.

Health and safety		**Yes**	**No**
Slight injured	Have you ever been slightly injured on duty (only First Aids needed and no more contact with healthcare services)?	66.66%	33.33%
Serious injured	Have you ever been seriously injured on duty (both First Aids and then medical treatment by healthcare services)?	19.70%	80.30%
Mental issues	Have you ever had anxiety, depression or emotional problems derived from your job?	40.90%	59.10%
Health issues	Have you ever had physical health issues derived from your job?	49.25%	50.75%
Protection (scale from 1 to 5)		Mdn	IQR
Risk taking	Risk-taking is part of first responding	4	2
Mental demands	First responding is mentally demanding	5	1
PPE-appropriate	The current PPE in my unit is appropriate	4	1
PPE-coverage	The current PPE in my unit covers all possible hazards	3	2
COVID19 PPE-appropriate	COVID-19 protection equipment was appropriate	4	2
Decision making (scale from 1 to 5)		Mdn	IQR
Amount of Information	The more information the better decisions	5	0
Alternatives to make decisions	Even under time pressure I consider all alternatives to make decisions	4	1

Trust on experience	I trust on my experience to make decisions	4	1
Errors in tense and hostile situations	I'm more likely to make errors in tense and hostile situations	3	2
Changes due to COVID-19	COVID-19 situation has changed our way to make decisions	3	2
Management (scale from 1 to 5)		Mdn	IQR
Overall opinion	Management in my unit do a good job	4	1.25
Information availability	I get complete and timely information about emergency situations	4	2
Issues addressed	Management in my unit address and resolve issues quickly	4	2
Updating tactics and protocols	Our tactics and protocols are constantly updated	3	2
Inputs	My inputs about safety are well received	4	1
Coordinated teams	I have always worked in a well-coordinated team	3	2
Gender equality	In my organization women have the same opportunities to advance as men	5	1
Training-workforce (scale from 1 to 5)		Mdn	IQR
Training-adequate	Training is adequate to me (according to the emergency situations I have to manage)	4	2
Trainees supervised	Trainees in my discipline are adequately supervised	4	2
Training new personnel	My first responding area/unit does a good job of training new personnel	4	2
More personnel	The more personnel in disaster response the better	4	1.25
Personnel-enough	The levels of staffing in my unit are sufficient to handle emergencies/disasters	3	2

Table 7 Self-reported experiences of participants in relation to health and safety, protection, decision making, management and training-workforce conditions.

Technology use: Figure 7 shows the number of technologies used by the surveyed first responders and Figure 8 the frequency of the use for the proposed technologies: *Web-based communications (Web-com), Situation Awareness Platforms (SA), Drones, Wearables (GPS, sensors and/or other devices), Predictive models/simulations (Simulations), Virtual Reality for training (VR) and Augmented Reality (AR) for training*. Note that these technologies are proposed by the ASSISTANCE project.

Most respondents (78.02%) reported the use of one (43.18%) or two (34.84%) of the proposed technologies. The most frequently used technology was wearables (78.03%) as it includes a wide variety of devices (GPS, sensors and/or other devices) followed by Situation Awareness Platforms (SA) (31.82%), Drones (30.30%) and Predictive models/simulations (20.45%). Robots (4.55%), Virtual Reality for training (VR) (6.06%) and Augmented Reality for training (3.79%) were the less used technologies.

The results summarized in Table 8 are of particular importance as they provide insights of the first responders' experiences with technology. Overall, first respondents considered that technology was useful but not determinant. Most respondents considered that technology was supportive (59.84%) and made their work easier (74.23%). Respondents felt safer using technology in their operations (60.60%) and

declared that technology avoided risk taking behaviours (74.20%). Respondents also had a positive opinion on the use of technology for training (i.e., VR and AR) disasters response (68.93%) and ordinary first responding activities (62.82%). Most respondents (79.53%) also reported that technology helped them to learn new ways for dealing with disasters. However, 68.93% recognized that technology had changed their ways of doing their job and the majority stated that technology required new skills and specialization (83.33%).

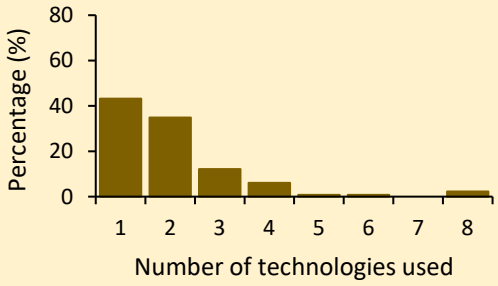


Figure 7: Number of technologies used by respondents.

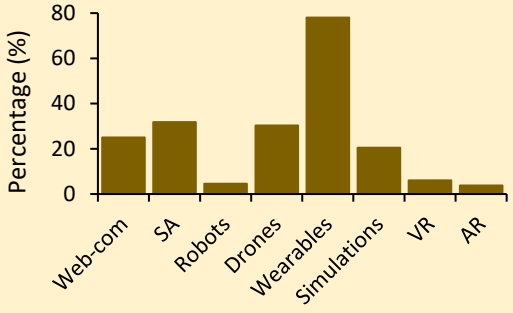


Figure 8: Frequency of each technology used by respondents.

Technology use (scale from 1 to 5)		Mdn	IQR
Supportiveness	I think the technology we use in our unit is supportive	4	1
Easiness	First responding is easier with technology	4	2
Safe feeling	I feel safe on duty when technology is used	4	1
Change in routines	Technology changes our routines (ways of doing the job)	4	1.25
VR/AR for training disaster response	Training technologies such as Virtual Reality and Augmented Reality are helpful for preparing for large-scale, infrequent disaster response	4	2
VR/AR for training ordinary activities	Training technologies such as Virtual Reality and Augmented Reality are helpful for preparing for ordinary first responder activities	4	2
Trust	I fully trust on technology for first responding	3	2
Specialization	Technology used by first responders requires new skills and specialization	4	1
Risk taking behaviours	Technology can avoid risk taking behaviours	4	1
Learning	Technology can help to learn new ways for dealing with disasters	4	1
Life or death decisions	I would rely on technology to make life or death decisions	3	2
Rely on technology	I rely on technologies to avoid the human errors in decisions	3	2
Computing-based management	Computing-based management is safer and more effective than human-centred management	3	2

Table 8 Self-reported experiences and opinions of participants in relation to technology.

When it comes to the confidence in technology the responses were not so conclusive. 46.21% fully trusted technology and 28.03% did not. Similarly, 43.93% would rely on technology for making critical decisions (life or death decisions) and 37.77% would not. Responses that confronted technology vs humans were also inconclusive.

Relying on technology to avoid human errors was supported by 35.57% and not supported by 40.14% of respondents. Finally, the idea that computer-based management is safer and more effective than human-centred management was only approved by 28.76% and not approved by 37.11 % of respondents.

Focus group

Block 1: Health, safety and protection (Figure 4):

- B1-Q1. *What thoughts, feelings, and associations come to mind first when you see these results?*
  In general participants agreed with the results. One participant reported that the percentage of injury was higher than his own experience. Another participant said, *"It seems that if minor bruises etc. were eliminated, there would be a lot fewer minor injuries reported".* Regarding risk taking as part of the job a participant said: "*The results are interesting, especially the fact that only 3/4 FRs feel they are taking risks while working. In my opinion, each trip carries a risk (for example, the possibility of contracting a disease such as COVID)".*
- B1-Q2. *What three main things impact on First Responders security?*
  The interviewees reported quality of training, quality of command, quality of equipment, proper selection of the teams for a specific task (experience and numbers), communication and non-technical skills.
- B1-Q3. *Is it possible to reduce or avoid injuries/health issues? How?*
  Participants agreed with the possibility to improve the situation. Some reported that the solution was improving the things mentioned in the previous question. One participant said: "*Same as it is done for years: proper training, adequate equipment and exercises and experience in operating the equipment gained through trials and exercises".* A participant mentioned the additional problem of cancer in firefighters and a prevention program conducted in his country.
- B1-Q4. *If you could change one thing about this situation, what would it be?*
  Two participants reported mental issues as the most important thing they would change. Another participant was in favour of avoiding serious injuries.

Block 2: Management, training and workforce (Figure 5):

- B2-Q1. *What do you think about these results? Do you agree?*
  All participants agreed that the presented results in general reflected the current situation. "The more information the better decisions" was supported by the majority. A participant said that "*decision making based on experience without data means nothing*". Another participant agreed with responses related to training and he added that "*new technology is more than welcome*".
- B2-Q2. *What is your own experience regarding this?*
  A participant recognized that, according to her knowledge, managers may need more experience to be efficient "*e.g. they must know the needs of personnel in the field to make good decisions*". Another participant stated that "*commanding and execution can be also trained to achieve speed and accuracy in routine responses" and that "support is needed in less common responses* ".

- B2-Q3. *Do you think it is possible to improve this situation? How?*
  All participants agreed that better training combined with technology could improve the current situation. A participant stated that "*improving training, including video and virtual. Use technology where it is justified when trying to engage in the development of solutions which are improving our job".*
- B2-Q4. *Do you have anything to add?*
  A participant reported that "*First response can be researched in terms of efficiency. It is not done in my country".*

Block 3: Technology (Figure 6):

- B3-Q1. *What do you think about these results? Do you agree?*
  Participants agreed on the overall results. One participant disagreed with the relation between technology and new skills and specialization "*I don't think technology requires new skills and specialization. End Users need to know how to operate an equipment and do not have to know how different algorithms work. HMI for end-users must be human friendly and as easy as it is possible to use."*
- B3-Q2. *Technology is supportive but not a key factor. Why?*
  All interviewees agreed. One participant clarified that technology is *"Key factor for training both commanders and personnel. Technology is supportive in a way that it can provide vital information or perform tasks which are very risky."* Another participant explained that "*Technology is nothing if you cannot use it to the fullest*".
- B3-Q3. *What is needed to increase the use and confidence on technology?*
  All participants agreed that technology should be suited to their specific needs and should be developed following their demands through a dialog with end-users. For instance, one participant stated that "*Technology should be developed with most experienced, knowledgeable and passionate commanders and firefighters. Then it has to be well tested. Unreliable technology is quickly discarded. It is better to have a tool that does one job very well than multifunctional tool doing each job without high reliability*". Another participant paid attention to Human Graphical Interfaces (HMI) and imagined the future trends of using technology: "*HMI for end-users must be human friendly and as easy as it is possible to use. The best option (future) is that the role of end-user should be only limited to supervision of automated work".*
- B3-Q4. *What would you like technology to do?*
  Here interviewees had different needs/options from performing heavy and simple tasks to the provision of vital information and advice on "what to do in a particular rare situation".

Lessons Learnt

The survey study combining a questionnaire and a focus group on past experiences has shown to be a proper method to increase the understanding of the current state of end-users of being safe and protected from danger or harm. It was particularly useful to get an overall picture of the key societal issues vs technology and to identify

the actual needs and therefore to define ways for innovation. This practice is recommended and can be extended to Societal Impact Assessment of similar projects.

The success factors are listed as follows.

- Both quantitative and qualitative information were collected.
- The study allowed to gather valuable information directly from end-users regarding their experiences, perceptions and attitudes towards several societal aspects.
- Responses can be contrasted with further evaluation of technologies and solutions proposed in the project during the pilot demonstrations to measure their potential effects on the end-users.
- The overall process was conducted online easily reaching participants while reducing time and cost.
- Anonymity avoided the potential influence of others on individual responses and consent of the participants for the data processing was not required.
- The use of questionnaire results was an appropriate tactic to elicit discussion among participants during the focus group.

The identified constraints are the following:

- The sample size in the questionnaire was small (132 responses).
- Gender balance was not reached in the questionnaire.
- The questionnaire was only available in English and Spanish.
- Only one focus group (7 participants) was possible to conduct because it was limited to the end-users involved in the project. More focus group sessions are desirable.
- There were some technical problems and part of the focus group session was not recorded. To solve this, participants were asked to write and send their comments after the focus group session.
- Transcriptions/texts were not fully analysed due to time constraints.

6. End-users: Assessing non-technical aspects for pilots

The problem

Innovation projects usually include pilots and practical demonstrations to test the proposed technologies and solutions preferably with the participation of end-users and stakeholders during the evaluation process. Whereas the requirements, functionalities, use cases and therefore the technical evaluations of technologies are often designed from the early stages of the project, there is also a need to address societal implications of such developments. In other words, the attitudes and behaviour of end-users and stakeholders when facing such technologies and solutions should be part of the Societal Impact Assessment. Similarly, precautions and good plans for assessing non-technical aspects (e.g. ethic, legal, etc.) during the pilot demonstrations are required.

To our knowledge, there is not a standardized method for the analysis of non-technical aspects during pilot demonstrations for innovation projects.

The approach

The GELS toolkit was designed within the ASSISTANCE project to integrate, monitor and evaluate non-technical aspects for the pilot demonstrations. It is an original idea of CEL designed in collaboration with UC and, for legal aspects, with the support of E-Lex. Pilot leaders, host organizers as well as the rest of partners are expected to work together according to this toolkit. The toolkit comprises tools to independently address Gender, Ethical, Legal and Societal issues:

1. Self-assessment tool (SAT): A sort of *Vademecum* for pilot leaders, host organizations and other partners to consider non-technical aspects when planning pilots and demonstrations.
2. Monitoring tool (MT): An approach for researchers to watch and analyse carefully human factors during pilots and demonstrations.
3. Analysis tool (AT): A tool for researchers to assess non-technical aspects after pilots and demonstrations.

Implementation

The matrix in Table 9 highlights the issues of the piloting activities (i.e., elements to address), the stages during which the process passes and the corresponding tools. The issues are characterized in terms of: Gender [Gen], Ethical [Eth], Legal [Leg] and Societal [Soc]. The intersections between categories (issues and tools) determine the specific guidance provided.

Stage	Tool	Key Issues			
		Gender [Gen]	**Ethics [Eth]**	**Legal [Leg]**	**Societal [Soc]**
		Gender integration and gender perspective	*Protection of participants*	*Privacy and data protection*	*FRs attitudes towards technology/training methods*
1. Design	Self-assessment tool [SAT]	Does the pilot integrate gender aspects? How many women and men are expected to participate? What are their roles? [SAT-Ge]	Does the pilot require recruitment? Is Informed Consent Form required? Are there any risks for participants? [SAT-Eth]	What administrative legal actions for data protection might the pilot require? [SAT-Leg]	What people (target groups and main actors) are planned to participate? What productive interactions are planned (dissemination/participatory)? What are the research and evaluation plans? [SAT-Soc]
2. Execution	Monitoring tool [MT]	Observe women and men performance Acquire data (e.g., participants self-reporting, opinion) Monitor changes (compare actual vs planned conditions) [MT-Gen]	Check compliance with ethical principles Monitor changes (compare actual vs planned conditions) [MT-Eth]	Check compliance with data protection and privacy (GPR) Monitor changes (compare actual vs planned conditions) [MT-Leg]	Observe participants performance and behaviour Acquire data (e.g., participants self-reporting, opinion) Monitor changes (compare actual vs planned conditions) [MT-Soc]
3. Evaluation	Analysis tool [AT]	Analyse and process data. Report main findings and deviations. [AT-Gen]	Analyse whether the ethical requirements and protective conditions of the pilot were as expected. Report main findings and deviations. [AT-Eth]	Analyse whether the legal requirements of the pilot complied with expectations. Report main findings and deviations. [AT-Leg]	Analyse and process data. Report main findings and deviations. [AT-Soc]

Table 9 Framework for monitoring, managing, and evaluating non-technical aspects of the pilot demonstrations in innovation projects.

The nature of this framework changes according to the stage of the timeline moving from questions to prompt the users during the early stages (SAT), observation and supervision of the pilot activities (MT) to the analysis and evaluation of non-technological factors (AT).

The relevance of the information may differ according to the nature of the pilot demonstrations being conducted. In fact, the users of the toolkit may not need to address all the elements to the same degree of detail during each of the stages. Indeed, some parts of the guidance may not be relevant in some pilots (i.e., if the pilot demonstration does not need external participants/volunteers to be recruited and used). However, it is important that partners will be aware of every element and stage. Furthermore, this guideline toolkit is also intended for those who may deal with other similar actions to ensure the integration, monitoring and evaluation of gender, ethical, legal, and societal aspects in similar projects.

Self-Assessment: The Self-assessment tool (SAT) is defined in the form of a list of issues through questions that users should consider when planning the piloting activities. The tool is conceived to cover basic and straightforward elements as precautions or tasks to be taken into account. However, as mentioned, the user may not require addressing all the elements to the same degree of detail and/or some parts may not be present or may be not as relevant as others. Tables 10-13 present the self-assessment tools for Gender, Ethics, Legal and Societal issues respectively.

Self-assessment- Gender

• SAT-G1.- Have women participated in technology design?
• SAT-G2.- Have women participated in the pilot design?
• SAT-G3.- Are women involved in organization and decision making of the pilot?
• SAT-G4.-What is the overall proportion of women participating in the pilot? Will be representative (e.g., 25-50 %)?
• SAT-G5.- Could you indicate the role of women during the pilot?
  • As members of the intervention teams
  • As simulated victims
  • Directly using the proposed technologies
  • As evaluators of technologies
• SAT-G6.- Will gender versus technology be part of the analysis?
• SAT-G7.- Will gender disaggregated data (male/female) be collected and analyzed?
• SAT-G8.- Will women (or gender experts) be involved in the collection and interpretation of data?
• SAT-G9.- Will you inform all partners involved in the pilot about gender aspects?
• SAT-G10.- Will gender findings be reported?

Comments: Additional clarifications and more detailed information of how gender aspects will be addressed are desirable (i.e., references).

Table 10 Self-assessment tool for gender aspects before the pilot.

Self-assessment- Ethics
• SAT-E1.- Does the pilot need to be approved by an Ethical Committee? • SAT-E2.- Does the pilot need recruiting participants? • SAT-E3.- Will participants be fully informed about: 1) the purpose of the pilot, 2) the rights of participants and 3) their benefits and risks coming from participating • SAT-E4.- What type of participants are expected? Will the pilot involve potentially vulnerable individuals or groups? • SAT-E5.- Is an Informed Consent Form required? • SAT-E6.- Does the data collection need profiling? • SAT-E7.- Will the pilot involve activities/interventions which may induce psychological stress, anxiety of humiliation of participants? • SAT-E8-Has the necessary training been given to the participants to arrive prepared for the pilot? • SAT-E9.- What measures will you implement to safeguard the rights and freedoms of the participants? • SAT-E10 – Are K-9 units involved? Have you considered direct and indirect effects on animal welfare?
Comments: Additional clarifications and more detailed information of how ethical issues will be addressed are desirable (i.e., references).

Table 11 Self-assessment tool for ethics before the pilot.

Self-assessment- Legal
• SAT-L1.- Will personal data be collected? • SAT-L2.- What categories of personal data will be collected? • SAT-L.3.- Will the images be collected? • SAT-L4.- What are the legal basis for personal data processing? • SAT-L.5. – When and how will the Assistance Privacy Policy and the consent form be given to the participants of the pilots? • SAT-L.6.- Who does what in relation to personal data processing (including, collection, recording, storage etc) in performing the pilots? • SAT-L.7.- What methodologies will be used to collect personal data? • SAT-L8.- What security measures will be implemented? (e.g., encryption, anonymization, etc.) • SAT-L9.- What will be the life cycle of the collected data • SAT-L10.- What supporting assets will be used? (e.g., operating system, database management systems, office suites, protocols, etc.) • SAT-L11.- How long personal data is planned to be stored? • SAT-L12. - Will the DPO be informed of the pilot activities? • SAT-L13.- Will a DPIA (Data protection impact assessment) be prepared before the performance of the pilot? • SAT-L14.- Will the data collected during the pilots re-used for other purposes than the Assistance project?
Comments: Additional clarifications and more detailed information of how legal issues will be addressed are desirable (i.e., references).

Table 12 Self-assessment tool for legal issues before the pilot.

Self-assessment- Societal
• SAT-S1.- Who will participate in the pilot? (e.g., First Responders, Technical partners, volunteers/citizens, etc.) • SAT-S2.- What their roles will be? (e.g., in relation to: 1) the activity, the technologies, the training methods, the simulated scenarios, etc. • SAT-S3.- What dissemination activities will be conducted? (e.g., manuals, briefings, presentations, exhibitions, social media/web, video explanations, webinars) • SAT-S4.- What participatory activities will be conducted? (e.g., meetings, workshops, tutorials, training sessions, end-user trials, guided exercises, quizzes, etc.) • SAT-S5.- What type of information will be collected? o Performance (e.g., situation awareness, tactical and strategical knowledge, decision-making time, tasks completion, accuracy, etc.) o Attitudes towards (e.g., risk, protection, access to information, communication, comfortability/affordability, usability, usefulness, confidence, learning, flexibility, etc.) • SAT-S6.- How information is expected to be collected and analysed? o Data collection methods and techniques (e.g., interviews, focus groups, questionnaires, direct observations, others?) o Data analysis: 1) qualitative (e.g., content analysis, hermeneutic analysis), 2) quantitative (e.g., descriptive and inferential statistics) • SAT-S7.- What are the potential benefits for stakeholders? (e.g., knowledge improvements, provision of additional information, experience, cooperation, staff training, publicity and reputation, etc.)
Comments: Additional clarifications and more detailed information of how societal aspects will be addressed are desirable (i.e., references).

Table 13 Self-assessment tool for societal aspects before the pilot.

Monitoring: The Monitoring tools are defined as instruments to watch and check pilot activities carefully in relation to Gender, Ethical, Legal and Societal aspects. The aim is to gather valuable information of facts, performances, preferences, thoughts, and behaviours of pilot organizers and participants in a systematic way. The monitoring mechanisms will depend on the nature of the pilot activities and what is being monitored. Several methods are likely to be used to gain feedback or responses from different perspectives (Table 14).

The described monitoring techniques are designed to acquire data (quantitative and qualitative) and should fit the purpose, be timely and applicable. Note that such monitoring activities should be analysed in advance to determine their feasibility and should be subject to mutual consortium decisions according to different goals, the limitations of those participating, equipment availability, time availability, etc. This process is as flexible as possible according to the progress of each pilot activity (e.g., current and new constraints and opportunities, availability of participants and resources, etc.).

Monitoring technique	Description	Collected information	
		Qualitative	Quantitative
Observation	Watching the procedures and participants. There are two main methods: 1) human observation, 2) automated observation (e.g., video cameras, recorders).	✓	✓
Benchmarking	Measuring performance actions/decisions by comparing them with accepted standards/references.	✓	✓
Usage	Gathering information of which technologies are used, or how they have been used.	✓	✓
Baseline	Establishing a minimum threshold/level (e.g. acceptance, quality, safety, etc.) considered to be necessary.		✓
Survey	Gathering opinions and attitudes from stakeholders and/or organizers trough questionnaires.		✓
Talking with people	Getting feedback from participants through interviews/focus groups (face-to-face, online, phone, etc.).	✓	

Table 14 Possible monitoring techniques for the pilot.

In this example, the monitoring tools for ethical and legal aspects (Table 15 and 16) are designed to check compliance and report any changes (compare actual vs planned conditions). The corresponding tools are presented as checklists where the researchers (ethical and legal experts of the consortium) can report key information gathered from audited documents and their observations, appreciations and feedback from participants.

Ethics monitoring template	Check	Comments /observations
MT-E1.- Approval by Ethical Committees (if applicable)		
MT-E2.- Pilot recruitment report		
MT-E3.- Pilot information sheet		
MT-E4.- Pilot monitoring reports (attention to the presence of vulnerable individuals/groups)		
MT-E5.- Pilot Informed consent template		
MT-E6.- Pilot data profiling report		
MT-E7.- Pilot monitoring reports (attention to causes of stress, anxiety or possible humiliation for participants)		
MT-E8- Pre-pilot debriefings and training courses		
MT-E9.- Pilot monitoring reports (measure to protect rights and freedom of participants)		
MT-E10 – Pilot animal welfare report (if applicable)		
Brief summary report:		

Table 15 Monitoring tool for ethics during the pilot.

Ethics monitoring template	Check	Comments/ observations
MT-L1.-Personal data has been collected		
MT-L2.- Special categories of data have been collected		
MT-L3.- Images have been collected		
MT-L4.- Consent are the legal basis for processing personal data, as provided in the privacy policy and consent form. Specify other legal basis for the data processing.		
MT-L5.- The privacy policy and the consent form were given before the performing of the pilot		
MT-L6.- Only partners were in charge to process data during the pilot		
MT-L7.- Personal data has been collected through electronic means		
MT-L8.- Security measures, in accordance with the article 32 of the GDPR, have been implemented. Specifying in the column "comments/observations" the typology of security measures, such as encryption, pseudonymization, etc.		
MT-L9.- 9. The data have been/will be processed in accordance with the legal provisions of the GDPR and used within the purposes of the Project. Specifying in the column "comments/observations" the life cycle of the data.		
MT-L10.- Appropriate support assess are used		
MT-L11.- The data will be stored only for the time necessary to fulfil the purpose of the project		
MT-L12.- The Data Protection Officer is informed of the pilots' activities		
MT-L13.- The pilot has a DPIA (Data protection impact assessment)		
MT-L14.- The data collected during the pilot will be re-used for other purposes than the project		
Brief summary report:		

Table 16 Monitoring tool for legal issues during the pilot.

The monitoring of gender and societal aspects aims at observing performance of participants, acquire data (e.g., participants self-reporting, opinion) and monitor changes during the pilot (compare actual vs planned conditions). The following illustrates a monitoring process that aims to collect feedback from end-users and stakeholders involved in the pilots. To collect data a combination of a questionnaire and interviews/focus groups can be defined. The proposed questionnaire (Table 17) is divided into three sections in relation to: 1) Usefulness (degree to which the technology can meet the needs of end-users), 2) Usability (degree to which the technology is reasonably easy to use and can be adopted) and 3) Impact (degree to which the technology is likely to modify practices and behaviours of end-users). Note that the questions on impacts derived from the past experiences of first responders from the previous case study (Section 5).

A. Usefulness	Data coding
A1.- This technology will cover our needs as first responder	5-point Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1)
A2.- This technology will improve our first response capabilities	
A3.- This technology will improve our protection as first responders	
A4.- This technology is applicable in my organization	
B. Usability	**Data coding**
B1.- I think that I would like to use this technology	5-point Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1). System Usability Scale (SUS)[2]
B2.- I found this technology unnecessarily complex	
B3.- I think this technology is easy to use	
B4.- I think that I would need the support of a technical person to be able to use this technology	
B5.- I find the various functions in this technology are well integrated	
B6.- I think there is too much inconsistency in this technology	
B7.- I would imagine that most people would learn to use this technology very quickly	
B8.- I find this technology awkward to use	
B9.- I would feel very confident using this technology	
B10.- I needed to learn a lot of things before I could get going with this technology	
C. Impact	**Data coding**
C1.-On a scale of 1-10 rate the importance of this technology for your job	Score from 1 to 10
C2.- On a scale of 1–10, to what extend this technology can be integrated in your first responding unit?	Score from 1 to 10
C3.- This technology is supportive in our job	5-point Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1)
C4.- This technology is likely to increase our feeling of security	
C5.- This technology is compatible with our practices and routines	
C6.- This technology is likely to alter our usual ways of doing the job	
C6.- This technology will improve our preparedness for disasters	
C7.- This technology will improve our preparedness for ordinary activities	
C8.- This technology will help us to learn new ways to deal with disasters	
C9.- I fully trust on this technology for first responding	
C10.- This technology will not require new skills and specialization	
C11.- This technology will prevent first responders to get injured	
C12.- This technology is likely to expand our tactics (new ways for dealing with disaster situations)	
C13.- I would rely on technology to make critical decisions (life or death decisions)	
C14.- This technology will avoid human errors in decisions	
C15.- This technology is likely to provide safer and more effective management than human-centred management	
C16.- This technology will make easier our job	
C17.- This technology is likely to reduce stress on duty	
C18.- This technology is likely to reduce risk taking behaviours	
C19.- This technology will facilitate interaction between co-workers	
C20.- This technology will reduce the number of first responders needed while improving efficiency	
C21.- This technology will improve the physical protection of first responders	

Table 17 Monitoring tool for societal/gender aspects during the pilot.

[2] *The Factor Structure of the System Usability Scale. In: Kurosu M. (eds) Human Centered Design. HCD 2009. Lecture Notes in Computer Science* . Lewis J.R., Sauro J. Berlin : Springer, 2009, Vol. vol 5619.

The questionnaire and especially the well-known System Usability Scale provides quantitative data (from Likert scale to scores). But it may be difficult to understand why respondents assign a specific score to the items without additional information. That is why a debriefing session (group session) should be conducted once the respondents have filled in the questionnaire to discuss, at a general level, the answers provided. The researcher will guide the discussion going through the questionnaire facilitating the debate among the different points of view. The interview can be recorded or transcribed by note takers to produce a qualitative report.

In this case, gender is analysed by disaggregating the data collected to explore differences/similarities between males and females. Basic descriptive analysis will involve the calculation of simple measures and the distributions of variables by gender to facilitate comparisons. For qualitative data the analysis depends on the research focus (e.g., human action and interaction, experiences and meaning of phenomena) and Coding (categorization, constant comparison, interpreting, etc.). In the following section we provide insights about these processes.

Analysis: The Analysis tool is defined as a framework divided into quantitative (Table 18) and qualitative (Table 19). The quantitative analysis involves statistical means for explaining (descriptive statistics) or predicting (inferential statistics). The qualitative data is essentially non-numeric information from different sources (e.g., interview transcripts, notes, video and audio recordings) so it is "sense making" or understanding participants in context-attitudes, rather than predicting or explaining.

A. Quantitative analysis
A1.- Preparing data
A1.1.- Coding: convert data into a numeric format, if necessary
A1.2.- Data entry: enter the data into a spreadsheet or database
A1.3.- Missing values: check and detect blanc entries
A1.4.- Transformation: create scale measures and/or collapse values into fewer categories
A2.- Descriptive statistics
A2.2.- Univariate analysis
A2.2.1- Frequency: calculate percentages/frequency of individual values or ranges (display in tables or graphs for better understanding)
A2.2.2.- Central tendency: calculate statistics Mean, Median and/or Mode
A2.2.3.- Dispersion: calculate range and /or IQR (Interquartile range) and/or standard deviation
A2.3.- Bivariate analysis
A2.3.1.- Correlation: calculate coefficients to determine that variables are related to each other (display scatterplots, regression lines and/or crosstabs for better understanding). Also use statistical testing to analyse whether the correlation is significant (calculate *p*-value).
A3.- Inferential statistics*
A3.1.- General Linear Model (GLM)
A3.1.1.- ANOVA (Analysis of variance): when comparing the effects of a dummy predictor variable on an outcome variable
A3.1.2.- Multivariate regression: when multiple outcomes variables are modelled as being predicted by the same set of predictor variables
A3.1.3.- Logit model: when the outcome variable is binary (0-1), and it is presumed to follow a logistic distribution
A3.1.4.- Probit model when the outcome variable is binary (0-1), and it is presumed to follow a normal distribution

A3.2.-Compare on group to a hypothetical value
A3.2.1.- One sample t-test (Gaussian population)
A3.2.2.- Wilcoxon test (non-Gaussian population)
A3.2.3.- Chi-square or binomial test (two possible outcomes)
A3.3.- Compare two unpaired groups
A3.3.1.- Unpaired *t*-test (Gaussian population)
A3.3.2.- Mann-Witney U test (non-Gaussian population)
A3.3.2.- Chi-square or binomial test (two possible outcomes)
A3.4.- Compare two paired groups
A3.4.1.- Paired t- test (Gaussian population)
A3.4.2- Wilcoxon test (non-Gaussian population)
A3.4.3.- McNemar's test (two possible outcomes)
A3.5.- Compare three or more unmatched groups
A3.5.1.- One-way ANOVA (Gaussian population)
A3.5.2.- Kruskal-Wallis test (non-Gaussian population)
A3.5.3.- Chi-square test (two possible outcomes)
A3.6.- Compare three or more matched groups
A3.6.1- Repeated-measures ANOVA (Gaussian population)
A3.6.2.- Friedman test (non-Gaussian population)
A3.6.3.- Cochrane Q (two possible outcomes)
• Note: The included statistical tests are suggested, and others are likely to be applied.

Table 18 Quantitative analysis for societal/gender data after the pilot.

B. Qualitative analysis
B1.- Categories
B1.1.- Content analysis: categorizing verbal or behavioural data to classify, summarize and tabulate the data
B1.2.- Narrative analysis: reformulation of stories by respondents considering individual context and experiences (i.e. a revision of primary qualitative data)
B1.3.- Discourse analysis: exploring naturally occurring talk and types of written text
B1.4.- Framework analysis: advanced way for familiarization, identifying thematic frameworks, coding, mapping, and interpretation
B1.5.- Grounded theory: it starts with an analysis of a single case to formulate a theory. Then, additional cases are examined to see if they contribute to the theory
B2.- Steps
B2.1.- Coding (categorization of data)
B2.1.1.- Open coding: organize raw data to try to make sense of it
B2.1.2.- Axial coding: interconnect and link the categories of codes.
B2.1.3.- Selective coding: formulate the story through connecting the categories
B2.2.- Identifying patterns and relationships
B2.2.1.- Repetitions: scan primary data for words and phrases most used
B2.2.2.- Data comparison: compare and discussing findings with literature
B2.2.3.- Missing information: search for expected aspects but not mentioned by respondents
B2.2.4.- Metaphors and analogues: compare primary research findings to phenomena and discuss similarities and differences
B2.3.- Summarizing data

Table 19 Qualitative analysis for societal/gender information after the pilot.

7. Citizens: Public opinion

The problem

Public opinion can provide evidence for policymaking while also generating ideas for new technologies and services. Similarly, citizens' inputs offer a unique understanding of societal concerns, desires, and needs, and thus, a better definition and targeting of innovation projects. That is why funding agencies often require the involvement of the public in projects. In most cases, citizens are the direct or indirect potential beneficiaries of technologies, solutions, and/or services proposed by innovation projects. Citizen involvement in projects may happen at three levels:

1. **Information.** Telling the public about the project by passing on information. This is a one-way communication with no level of public influence on the project. This is often used with the aim to enhance the influence of a given project on society.
2. **Consultation.** Asking for opinions and/or ideas. This is two-way communication with a moderate level of public influence on the project. It is normally used to ask and listen to the society in relation to general aspects connected with the project at hand (e.g., perceptions/opinions on safety and security).
3. **Collaboration.** The research team and civil society work together. This strategy uses dialogue-based communication (see CTA principles in Section 2) with a reasonable influence of the public (e.g., end-users, stakeholders, citizens) on the progress of the project and its outcomes.

The citizen engagement at the collaboration level is used when citizens are the direct end-users/beneficiaries of the project developments. In such a case, citizens need to be well informed about the project (they must know it) so they can provide useful feedback. The consultation level is easier, but it requires a good methodology to acquire useful information. This may include the use of well-designed questionnaires or interviews to collect data in a systematic way.

The approach

Here we show a case study of a large scale survey to explore citizens perceptions and attitudes in the context of disaster response. The study was conducted as part of Societal Impact Assessment within the ASSISTANCE project. The aims of this example are:

- To report on the methods for the development and implementation of the questionnaire.
- To briefly summarise the key findings.
- To draw conclusions about the importance of public perception and attitudes towards disasters response.

Implementation

The survey concerned 1.014 respondents from five countries representative of northern (Sweden), Southern (Italy and Spain), Eastern (Poland) and western (France) of Europe (Figure 9).

To provide exhaustive information on the survey and to facilitate reproducibility, we follow the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

Figure 9: Countries involved in the study.

Design: The survey was designed to cover three main factors: 1) risk perception (likelihood, impact and self-capabilities) for five disasters: *Extreme weather conditions (W), Fire (F), Earthquake (E), Hazardous material accident (H) and Terrorist attack (T)*, 2) predisposition to seek for preparedness (pros and cons) and 3) opinion on First Responding (capabilities and improvements). The questions to investigate these factors are listed in Table 20. The participants were also asked to provide socio-demographic information, including their age, gender, the maximum level of education achieved and occupation.

Ethics: The questionnaire was anonymous, and the privacy policy of the individual's posted information was noted (e.g., the purpose of the study, length of time to the survey, personal data and data protection, withdrawal rights, etc.). Due to the nature of this study written informed consent was not required. However, respondents gave consent to participate by filling in the agreement part of the survey form.

Development: A pilot questionnaire was conducted involving 56 participants allowing us the possibility to know whether a designed questionnaire fulfilled the purpose of the study before the actual large-scale survey (i.e., the respondents were asked face to face whether the questions were clear and how they interpreted them as expected). The English version of the questionnaire was reviewed by two external experts and then translated into the target languages by native speakers. During the translation process we paid special attention to achieve semantic, idiomatic, experiential, and conceptual equivalence to the original version. The initial translation into each target language was made by two independent translators per language to detect and resolve subtle differences/discrepancies. Also, the resulting versions were back-translated to ensure the accuracy of the translation. Then, the online prefinal versions were sent again to the translators for checking and final approval.

Check-box answers were used to reduce the time to answer each item. While 5 and 3-point Likert scales had a neutral option 4-point Likert responses did not (i.e., participants were required to form an opinion). The usability and functionality of the electronic questionnaires were tested before fielding the final versions.

	Variable	Question	Available answers
Risk Perception	*Likelihood*	How likely do you consider that* will occur nearby?	On a scale from 1 "Highly unlikely" to 4 "Highly likely"
	Impact	If* occur in your vicinity, what in your view is the risk for you and your family?	On a scale from 1 "Low risk" to 4 "Critical risk".
	Self-capability	Which statement best represents your self-preparedness for*.	On a scale from 1 "I don't know what to do" to 3 "I know what to do"
Attitudes towards preparedness	*Pros*	Getting ready is worthwhile because: • It is easier to get back to normal (*Resilience*) • I can have information about what to do (*Information)* • Acting makes me worry less (*Confidence*) • If I am ready, I can help others (*Assistance*)	On a scale from 1 "Strongly disagree" to 5 "Strongly agree"
	Cons	Getting ready is not worthwhile because: • Getting ready won't make a difference (*Uselessness*) • It is not my responsibility (*Buck-passing*) • I would rather not think about bad things happening (*Avoidance*) • It doesn't matter; disasters don't happen where I live (*Denial*) • It takes too much time, effort, or money (*Cost*)	
First Responding	*Capabilities*	In your opinion, the training level, and resources for first Responders in (Europe/your own country/your village-town-city) are:	On a scale from 1 "Very poor" to 5 Excellent"
	Improvements	How important to you are the following aspects to improve disasters response (M*ore personnel/Visible leadership and decision-making/Multi-agency coordination/Updated emergency plans/citizens collaboration/Training /Use of new technologies*)	On a scale from 1 "not important" to 5 "Very important"
* Extreme weather conditions (W), Fire (F), Earthquake (E), Hazardous material accident (H) and Terrorist attack (T)			

Table 20 Survey questions and the available answers.

Survey distribution: A survey company was hired following the UC procedures based on best value for money and to provide the answers given the targeted countries and number/gender/age of respondents needed, also ensuring the quality control, before and during the data collection. The questionnaire had in total 36 items in addition to sociodemographic information. Items were randomized to prevent biases in responses. Overall, the questionnaire took approximately 10-15 min to complete.

The responses (only one per participant) were automatically captured and checked through the online survey system. Errors in survey response were assumed to be random, and not correlated with any demographic or personal characteristics. The timeframe for the data collection was from 1st to 14th November 2020.

Participants: A dedicated effort was made to use a representative population sample i.e. different ages, several education levels and socio-professional profiles. It is important to note that a requirement of this study was to collect responses from an appropriate gender balance (Males 50.3 %; Females 49.7 %) for further gender analysis. Figure 10 shows the characteristics of the surveyed participants (age mean 41 ± 22.7 years).

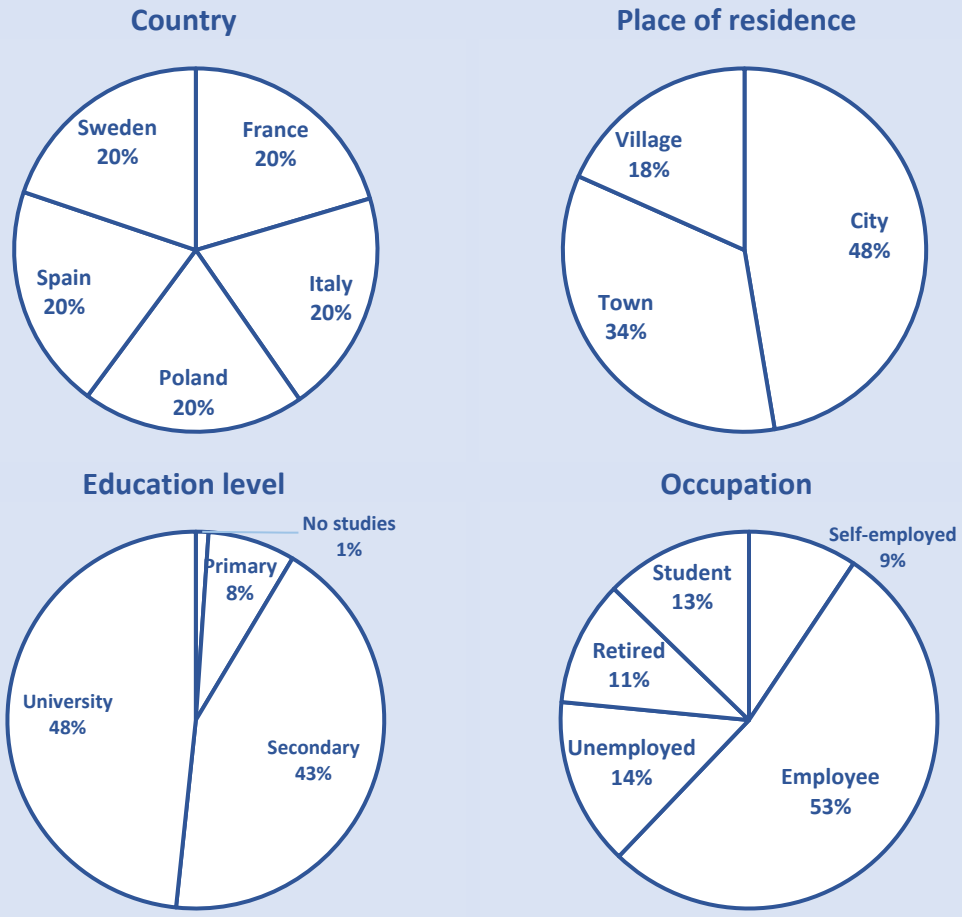


Figure 10: Baseline characteristics of surveyed participants. City (>50.000 inhabitants); Town (5.000-50.000 inhabitants); Village (<5.000 inhabitants).

Analysis: Individual risk perception was computed as the resulted value from the following equation: Risk=(Likelihood*Impact)/Self-capacity. Regarding attitudes towards preparedness, we sum the scores assigned by respondents to the Pros and Cons (reverse scored) to measure their predisposition to seek for preparedness. The continuous variables are expressed as Mean ± Standard Deviation (SD). The categorical variables are expressed as percentages.

Non-parametric methods were used in statistical inference Mann-Whitney U test to compare two samples (assessing whether the two samples come from the same distribution) and Kruskal–Wallis test[3] to measure the differences between three or more samples (using scores with their rank numbers and tests whether these are equal over samples). Scale reliability was assessed by Cronbach's alpha (coefficient between 0 and 1) assuming a cut-off acceptability value of 0.7. For all analyses performed *p*-values ≤ 0.05 were considered as statistically significant. The JASP statistical program v0.14.1 was used for statistical tests throughout the entire study.

Results

Reliability: The extent to which participants respond to the items in a similar manner reflects internal consistency of the questionnaire. The Internal reliability measures the degree of correlation between different items of the same section within the questionnaire. Cronbach's alpha -a widely used reliability coefficient- was calculated for the questionnaire overall and for each section. The internal reliability of the different sections in the questionnaire is shown in Table 21. Cronbach alpha coefficients were larger than the threshold of 0.7 generally considered in social sciences.

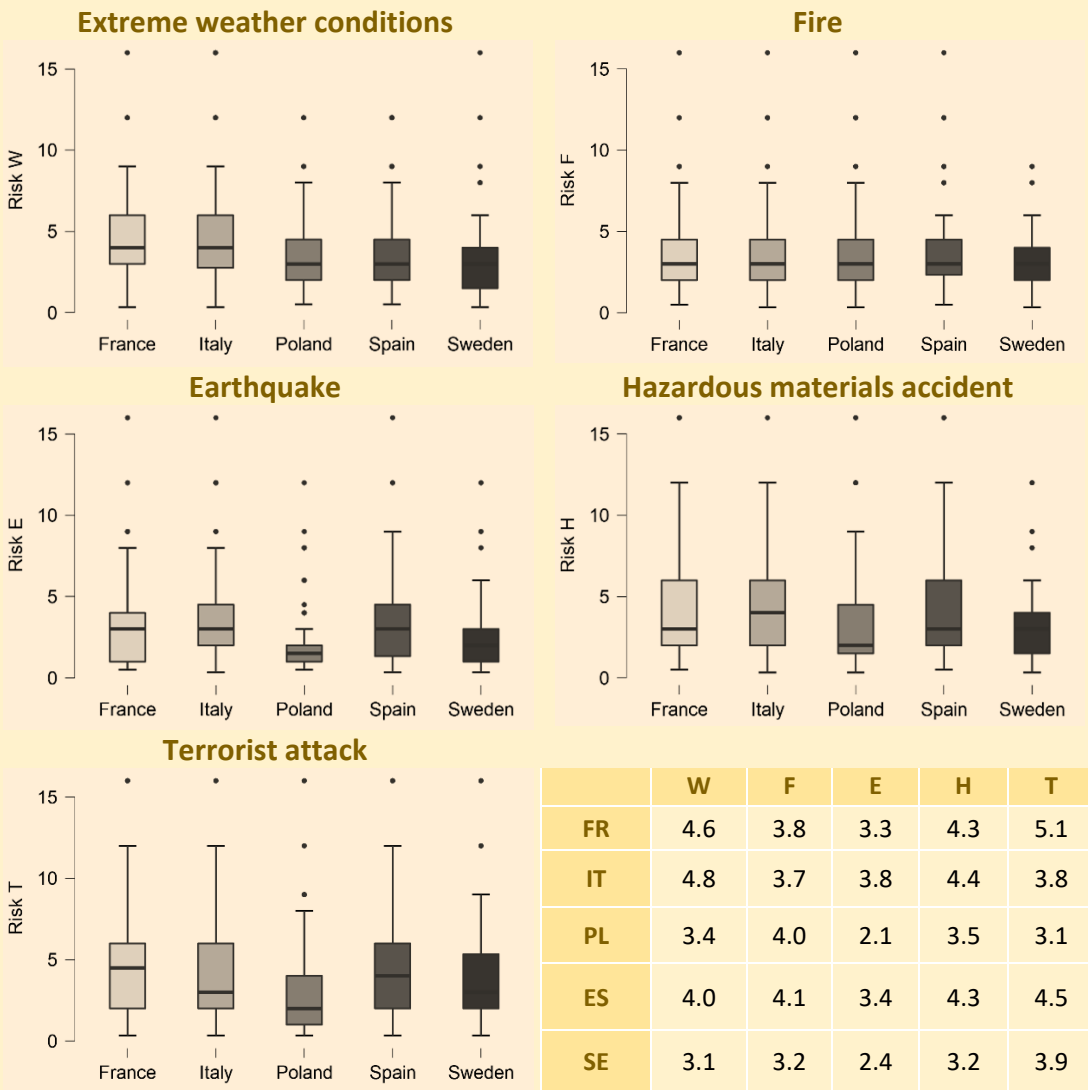
	Variable	N items	Cronbach's alpha
Risk Perception	*Likelihood*	5	0.73
	Impact	5	0.84
	Self-capability	5	0.76
Attitudes towards preparedness	*Pros*	4	0.74
	Cons	5	0.84
First Responding	*Capabilities*	3	0.86
	Improvements	7	0.89

Table 21 Internal reliability for the sections of the questionnaire.

To show the potential of the obtained dataset, we present a summary of the main findings through descriptive and inferential statistics.

Risk perception: These questions aimed at increasing our understanding of individual risk perception with respect to the occurrence of different disasters. Risk perception was computed here as the resulted value from: Risk=(Likelihood*Impact)/Self-capacity. Figure 11 shows the box plots and the mean values of the resulted scores per country. A Kruskal-Wallis H test showed that there were statistically significant differences in risk perception between countries: Extreme weather conditions (Chi square = 54.95, $p < .001$), Fire (Chi square = 16.95, $p = .002$), Earthquake (Chi square = 99.33, $p < .001$), Hazardous materials accident (Chi square = 26.20, $p < .001$), Terrorist attack (Chi square = 46.15, $p < .001$).

[3] Kruskal, W.H., Wallis, W.A. (1952). Use of ranks in one-criterion variance analysis. J. Am. Stat. Assoc. 47, 583–621 and errata, ibid. 48, 907–911.



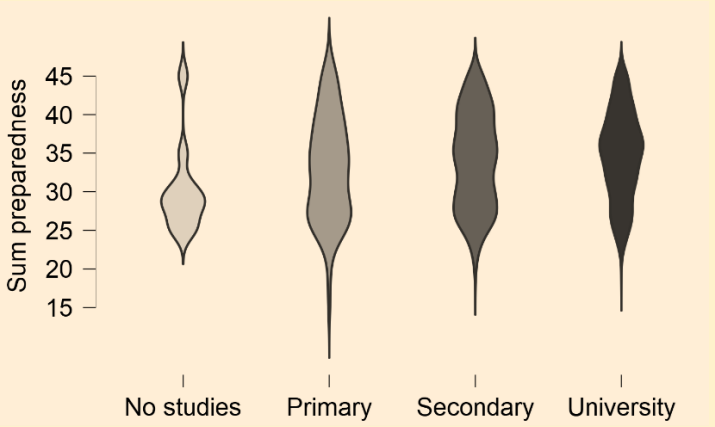
	W	F	E	H	T
FR	4.6	3.8	3.3	4.3	5.1
IT	4.8	3.7	3.8	4.4	3.8
PL	3.4	4.0	2.1	3.5	3.1
ES	4.0	4.1	3.4	4.3	4.5
SE	3.1	3.2	2.4	3.2	3.9

Figure 11: Box-plots and mean values of individual risk perception per country.

Attitudes towards preparedness: To show an overview of the predisposition of citizens for seeking preparedness for disasters, we summed the item scores assigned by respondents. The resulting scores ranged from 9 to 45. Note that scores from *Cons* of preparedness (see Table 17) were reversed.

Figure 12 shows violin plots as well as the Mean and Standard Deviation. Kruskal-Wallis H test was conducted to examine the data and significant differences (Chi square = 12.52, p <.01, df = 3) were found among the five categories of participants (No studies, Primary, Secondary and University).

First responding: This section of the questionnaire aimed to capture public opinion about 1) the capabilities of first responders and 2) the potential improvements for disasters response. Although citizens are not experts, they were assumed to provide valuable information to the proposed items.

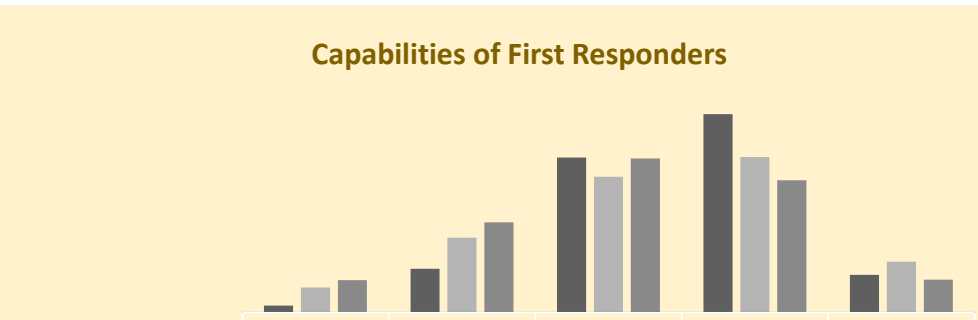


	Mean ± S.D.
No studies	30.09 ± 5.71
Primary	32.98 ± 6.63
Secondary	33.98 ± 6.15
University	34.68 ± 5.66

Figure 12: Violin-plots, Mean and Standard Deviation of attitudes towards preparedness by educational level.

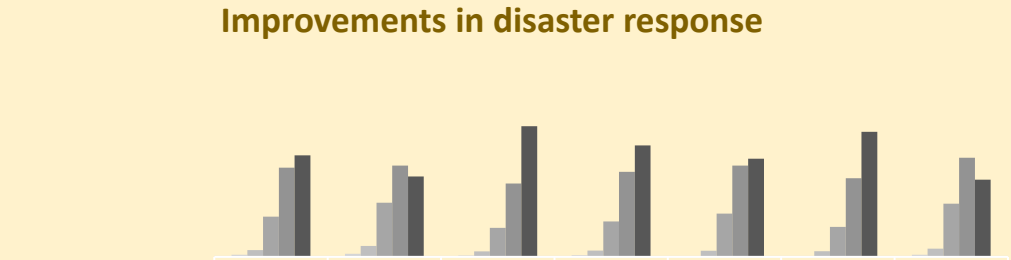
1) Capabilities of first responders: Figure 13 shows the responses on first responding capabilities in Europe, own country, and the place where respondents live (village/town/city). These results allow us to explore the confidence the public may have in first responders across different geographical areas. According to the results of the questionnaire 54% participants rated first responders' capabilities as "good" or "excellent" in Europe, 47% in own country and 37% in their village/town/city. Additionally, significant differences were found comparing responses using the Wilcoxon Sum Rank test. The perception of the first responders' capabilities in Europe is significantly greater than their own country ($W=466752$, $p < .001$, one-tailed) and municipality ($W=623357.5$, $p < .001$, one-tailed). Similarly, the scores for first responders' capabilities in their own country were significantly higher than the place where respondents live ($W=569541.5$, $p < .001$, one-tailed). Therefore, we verify that the perception of first responders (well training and enough resources to deal with disasters) changes across geographical areas being higher at European and country levels than at local level.

2) Improvements for disasters response: The aim of this question was to capture respondents' opinions about potential enhancements for disasters response. These results allowed us to explore the public opinion, especially in relation to items directly related to the improvements proposed by the project. As expected, the response pattern was similar in all items with a majority of "important" and "very important" responses. However, significant differences were found between samples (Chi square = 197.62, p <.001, Kruskal-Wallis test). By looking at results in Figure 14 around half of respondents agreed when rating the following improvements as very important: "Multi-agency coordination", "Updated emergency plans" and "Training". Interestingly, these are improvements addressed by the ASSISTANCE project. However, contrary to our expectations "Technology" was not considered in the top list of improvements for disasters response.



	Very poor	Poor	Average	Good	Excellent
Europe	2	10	35	45	9
Own Country	6	17	31	35	12
Yor village/town/city	7	20	35	30	7

Figure 13: Response frequencies (%) about the first responders' capabilities.



	Personnel	Leadership	Coordination	Updated plans	Citizens	Training	Technologies
Not important	1	1	1	1	0	0	1
Slighthly important	3	5	2	3	3	2	3
Moderately important	17	23	12	15	18	13	22
Important	37	38	31	35	38	33	41
Very important	42	34	54	46	41	52	32

Figure 14: Response frequencies (%) about improvements for disaster response.

Lessons Learnt

Understanding perceptions, attitudes and opinions of citizens may help to identify constraints and opportunities for innovation projects. Questionnaires are fundamental instruments to acquire such information in a systematic way. In the described example we conducted a survey to consult EU citizens in relation to general aspects connected with the ASSISTANCE project, i.e., risk perception, self-preparedness and first responding issues for disasters response. Datasets produced here do not only have scientific value but also have the potential to inform project partners (researchers and end-users) for improving the project (detecting needs and improving developments) and policymakers and first responders for developing risk management policies, training and communication campaigns, thus improving disaster response and resilience of society.

The success factors are listed as follows.

- Conducting a pilot questionnaire allowed the possibility to detect incompatible issues and the appropriateness of questions and to know whether a designed survey fulfils the purpose of the study before the actual large-scale survey.
- The questionnaire permitted to cover as many aspects as possible related to the topic at hand (i.e., disasters response).
- Hiring a survey company ensured the highest response rate, appropriate sampling (e.g. > 1.000 responses) and getting massive amount of information in a short period of time.
- The use of the online questionnaire gave the best sense of anonymity and privacy which maximizes comfort for those answering.
- Data collected could be analysed statistically. For instance, the use of statistical inference allowed going one step beyond a simple description of data and therefore drawing more consistent conclusions.
- The summary of the project included in the questionnaire enabled dissemination to a high number of citizens.
- Translations of the questionnaire into several languages allowed scalability (i.e., the possibility to reach responses from several countries) while enabling the involvement of several partners during the translation process, also those not directly related to the study.
- The complete description of the questionnaire granted reproductivity and the possibility to increase the response sample sizes.
- As the questions were general, the produced datasets can be extrapolated to other related analyses (e.g., compare and contrast other research studies, define new ideas and projects, etc.).

The identified constraints are the following:

- The pilot questionnaire used a reduced number of people (n=54).
- The aspects covered by the questionnaire were general and/or unfamiliar to the respondents. This is likely to generate ambiguity and or misunderstanding (differences in interpretation of the questions).
- Survey taking fatigue. The survey had 34 items so it might be perceived as too long and/or including questions irrelevant to the respondents
- Translation of the questionnaire into several languages was time consuming and required the commitment of many people.
- Hiring a survey company had a monetary cost.
- Respondents belonged to databases of the survey company and were given a monetary incentive for their participation. In such cases dishonesty, indifference and lack of motivation can be important issues.
- The survey was unsuitable for individuals with a visual or hearing impairment, or other impediments such as illiteracy.
- Although the pilot-questionnaire (face validation) and the good internal reliability (Cronbach alpha >0.70), it was not possible to conduct a content and construct validity of the questionnaire

8. Conclusions

Societal impacts of R&I projects (i.e., perceptions and attitudes of stakeholders and possible effects of technological solutions on society) need to be tackled systematically. However, the societal effects of projects can be complex and can happen at various levels. This entails several facets likely to be analysed in different ways.

The intention of this document is to assist in determining what can be done to address the societal impacts within safety and security R&I projects. Complex problem-solving guiding principles were proposed as the global strategy and good practice examples have been presented when analysing the following societal questions within the ASSISTANCE project:

1) How do we advance the effects of a project on society?
2) What are the potential effects of technologies and solutions on end-users?
3) What is the public perception regarding the problem at hand?

The concluding remarks are the following:

- Societal Impact Assessment needs to be integrated effectively into wider assessments and decision-making processes of projects.
- Conducting Societal Impact Assessment requires a variety of scientific based methods being quantitative and/or qualitative based on the essential issues under consideration.
- Dealing with the social aspects of project implementation requires the active participation of the partners, end users and stakeholders (e.g. citizens). This process should start as early as possible.